

# KODAK

## REFERENCE HANDBOOK



MATERIALS • PROCESSES • TECHNIQUE

# **KODAK**

## **R E F E R E N C E**

## **H A N D B O O K**

**MATERIALS • PROCESSES**

**TECHNIQUE**

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**EASTMAN KODAK COMPANY • ROCHESTER, N. Y.**



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# INTRODUCTION

## KODAK REFERENCE HANDBOOK

**M**AINTENANCE of the high artistic and technical standards, today demanded by photographic craftsmen in all fields, requires complete information on the photographic materials employed. The Kodak Reference Handbook provides a wealth of practical recommendations and technical data on a large group of Kodak materials and apparatus used for still photography in black-and-white or color, and for amateur motion pictures in color.

The information, as well as the form in which it is presented, is the result of collaboration between the Kodak Research Laboratories, experienced photographers, and photographic technicians. The Kodak Reference Handbook has been found extremely useful by those who enjoy photography as a hobby, those whose interest is professional, and those who employ it in special applications.

New Kodak Reference Handbooks have as individual sections the latest revisions of the Kodak Data Books on Lenses, Films, Filters, Color Films, Papers, Formulas and Processing, and Copying. This method of assembly offers you two important benefits: you have the latest published information in each section of your Handbook, and you can keep your Handbook up-to-date by replacing entire sections with newly-revised Kodak Data Books—see next page for details of the revision program.

To determine which is the most recent information on a given subject, compare the dates of the sections or Data Sheets in which the information appears. The date is located at the bottom of the first page of each section, and in small type at the end of each Data Sheet.



## QUICK REFERENCE SYSTEM

The Kodak Reference Handbook employs several mechanical aids which facilitate locating information. The desired section is first selected by means of its index tab. Then the subject is found by using the strip index and black patch on the appropriate page, as shown, or from the table of contents on page 1 of each section.



**Paging:** Each section of the Handbook is now numbered as a separate unit, and bears the title of the section, i.e. *Kodak Lenses* 3, 4, etc.

## HANDBOOK REVISION PROGRAM

Your Handbook can be kept up-to-date by replacing entire sections with newly-revised Data Books which are specially planned and punched for this purpose. Features of the revision program are:

**1. Registration.** If you have not already registered your Kodak Reference Handbook or Photographic Notebook, complete and return the card inside the front cover. You need register only one of these books, since this program serves owners of both.

**2. Notification.** As a registrant you will receive future issues of the *Handbook-Notebook News* announcing newly revised Data Books to replace Handbook sections, as well as a listing of articles on special photographic subjects for the Notebook.

**3. Purchase.** You may then purchase the newly revised Data Books from your Kodak dealer, and insert them in the Handbook. *In general, to keep your Handbook up-to-date*, you will purchase major revisions of those Data Books corresponding to the various Handbook sections. These will carry the designation "Third (Fourth, Fifth, etc.) Edition," and replace Handbook sections with lower edition numbers or without edition designation. When a Data Book is reprinted with only minor revision, the Edition number or copyright date is not changed, but the date of the Printing is added, as, Third Edition, 1947 Printing. The extent of the revision is indicated inside the front cover of each Data Book.

## KODAK PHOTOGRAPHIC NOTEBOOK

The Notebook provides a binder for material supplementing the Reference Handbook, such as Data Books, special articles on photography, and your own darkroom notes. The Notebook can be purchased from Kodak dealers, complete with ruled notepaper, index separators, and a listing of special photographic articles available on request.

# KODAK PUBLICATIONS

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The following books on various aspects of photography are stocked and sold by Kodak dealers, or can be ordered through them. Owing to shortages of certain printing and binding materials, however, some of the publications listed may not be available in sufficient quantity to meet all demands.

## INTRODUCTORY

*How to Make Good Pictures*—A complete, nontechnical book for the amateur picture maker. 240 pages.

*How to Make Good Movies*—A nontechnical but thorough discussion of the details of amateur movie making. 230 pages.

*Developing, Printing, and Enlarging*—A completely illustrated instruction booklet for the beginner. 24 pages.

*This Is Photography*, by T. H. Miller and W. Brummitt—Logically organized information on photography informally presented for those who already know something about it, and want to know more. 260 pages.

*Picture Taking Outdoors with Kodak Films*—An illustrated booklet giving camera settings for typical subjects, and a 20-minute course in picture taking. 24 pages.

## FOR THE ADVANCED WORKER

*Kodak Data Books*—A series of booklets covering various phases of photography. Each Data Book is a complete unit, containing general information on its subject together with recommendations and technical data for suitable Kodak materials. With the exception of the last three listed, the Data Books parallel the corresponding sections of the Kodak Reference Handbook. Included are:

Kodak Lenses, Range Finders, and Shutters

Kodak Films

Filters and Pola-Screens (illustrated in color)

Kodachrome and Kodacolor Film (illustrated in color)

Kodak Papers

Formulas and Processing

Copying

Slides

Photography with Kodachrome Professional Film (illustrated in color)

Infrared and Ultraviolet Photography

*Kodaguides*—A series of handy, pocket-size books, cards, and calculators giving working data and recommendations for using films, papers, lenses, filters, etc., under various conditions.

*Kodak Photographic Notebook*—A convenient binder for darkroom notes and other material supplementing the Kodak Reference Handbook. Supplied with fifty sheets of note paper, five separator pages, and a list of photographic articles available on request.



*Wratten Light Filters*—A complete catalog of the spectrophotometric properties of all Wratten Filters. 86 pages.

*Photomicrography*—A manual on photography through the microscope. 174 pages.

*Commercial Photofinishing*—A general survey of the fundamentals of photofinishing—plant layout and equipment, records, processing and printing techniques, and quality control. 48 pages.

*Eastman Motion Picture Films for Professional Use*—Technical data for the

Eastman Films supplied for professional motion-picture production, and for 16-mm. Kodachrome Film. 72 pages.

*The Theory of the Photographic Process*, by DR. C. E. K. MEES—A review and summary, by the leading authority on the subject, of the scientific work of the past fifty years which has contributed to the knowledge of the photographic process. 1124 pages.

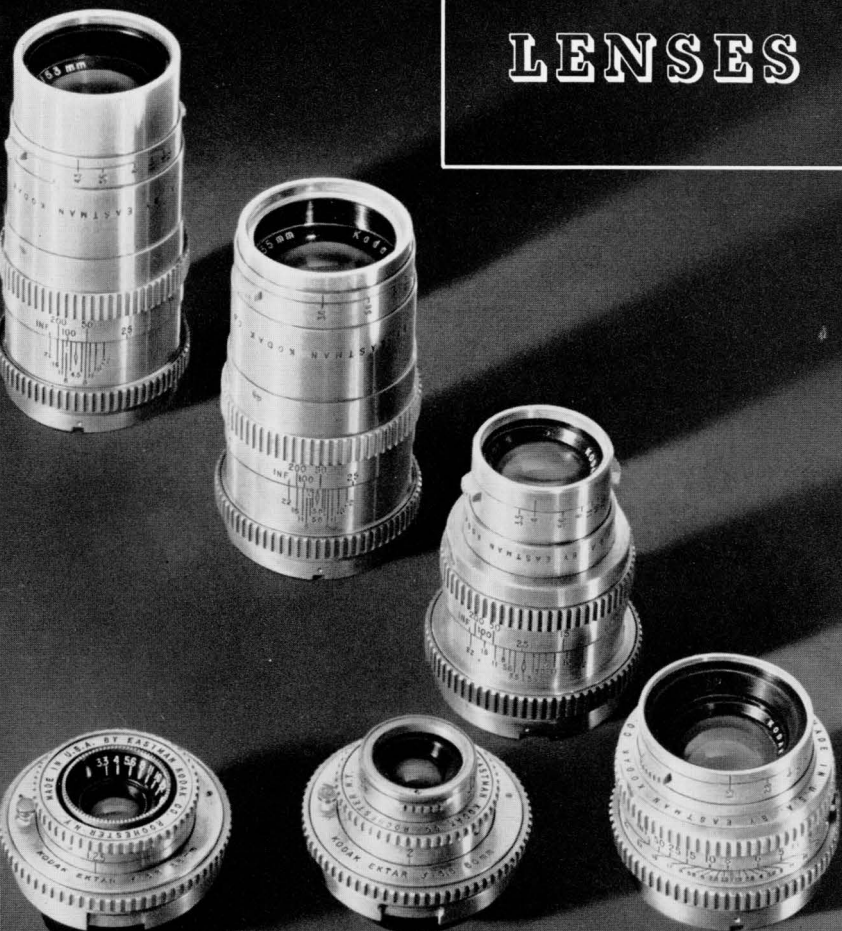
\* \* \*

In addition to materials for general photographic work, the Eastman Kodak Company manufactures special photographic materials for nearly every known use of sensitized products. Some of the fields for which such materials are regularly supplied include spectroscopy, aerial photography, photomicrography, radiography, graphic arts, and industrial, documentary, and template photography.

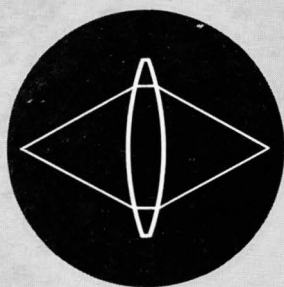
Literature describing Kodak products and articles about various photographic subjects are available on request. At the present time, bibliographies of books and articles dealing with many specialized aspects and applications of photography are also available on request.

Those who wish information about special applications of photography, or who need help with other photographic problems, are invited to write to the Sales Service Division, Eastman Kodak Company, Rochester 4, N. Y.

# KODAK LENSES







# KODAK LENSES

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Lens  
Specifications

Lens Properties

Lens Corrections

Lens  
Performance

Kodak Camera  
and Enlarging  
Lenses

Ciné-Kodak  
Lenses

Kodak  
Supplementary  
Lenses

Care of Lenses

Kodak Range  
Finders

Kodak Shutters

Optical Formulas



# KODAK LENSES

## RANGE FINDERS AND SHUTTERS

PHOTOGRAPHY finds ever wider application in specialized and technical fields on the part of both the professional photographer and the serious hobbyist. This has led to greater emphasis on the correct and accurate use of the most important part of the camera—the lens. Higher standards in picture quality, the extended practice of color photography, the greater interest in picture taking at all times regardless of adverse light conditions, and increased activity in photographing small objects—all demand more attention to such matters as lens correction, lens definition, exact focus, effective lens aperture, depth of field, proper use of supplementary lenses, etc. The excellence of a lens or shutter alone will not necessarily assure precise results; their properties must be fully understood and correctly applied.

The information presented on the following pages is intended to afford a thorough understanding of lens and shutter operation. In addition, the characteristics of each Kodak Lens are described in detail in Specification pages. Optical formulas are included for the convenience of those faced with special problems.

### **“LUMENIZED”\* LENSES**

The most recent advance in Kodak lenses is the wide application of Lumenizing. Many Kodak lenses now bear a thin, hard coating of magnesium fluoride to reduce surface reflections and consequently flare light and spots. Picture quality is improved in shadow contrast and detail and in shadow color purity of color pictures. Because of the reduced tendency to veiling and spots, the camera has greater freedom of position with regard to the sun or bright lights.

Lumenizing slightly increases the speed of a lens having many glass-air surfaces. More light is transmitted to the highlights, less to the shadows. In color work the increase may amount to as much as a third of a lens opening setting; in black-and-white no allowance should be made.

When all the elements including condensers of a projection system are Lumenized, screen brightness is increased—50% in the case of the Kodaslide Projector, Model 2A. The projected picture quality is also improved, mostly in the shadows.

Lumenized enlarger lenses tend to give improved highlight detail, especially from negatives of high contrast or large shadow areas.

Lumenized lenses, as currently made, bear a circled "L" engraved on the mount. Treated lenses can also be identified by the slight tint seen by reflected light. The lens is uncolored by transmitted light. Color rendering is not affected.

Dirt on Lumenized lenses tends to cancel the advantages of Lumenizing. Oil spots look like holes in the surface. Lumenized lenses can and should be cleaned in the usual way, as described elsewhere.

Recently designed Ektar lenses have mechanical improvements in the mount, also designed to reduce flare light.

## ***Lens Properties***

### **FOCAL LENGTH**

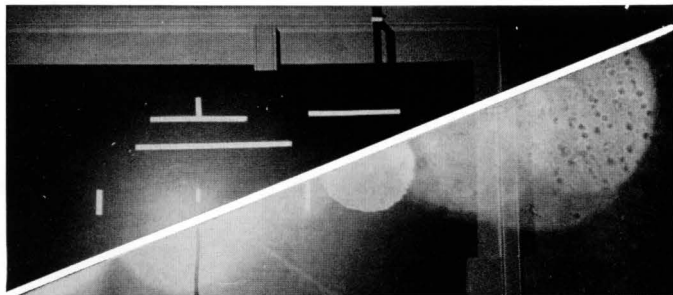
A fundamental characteristic of any lens is the focal length. This controls the image distance and size, and ordinarily determines the usable negative size. The focal length is approximately the distance from the lens to the image of a distant object. Methods of finding focal length and the relation between it and subject and image distances are given on pages 31 and 32.

### **Photographic Perspective**

Human eyes see in three dimensions, but a lens reproduces a view in two dimensions only. The missing dimension, depth, is suggested mainly by the relative size and position of the various objects in the picture. The relation of these objects, or perspective, and therefore the naturalness of the picture, is influenced by the position of the camera.

**3**

**Laboratory test comparison of a Lumenized and an untreated lens. A bare lamp was photographed against a blackboard with—Upper—Lumenized lens—Lower—untreated but otherwise similar lens. Note the freedom from flare effects, and better contrast by the Lumenized lens.**



A camera position too close to the subject results in an exaggeration of the parts nearest the lens.

Correct perspective in the final picture depends largely upon the distance at which it is viewed. Contact prints should be viewed at a distance equal to the focal length of the lens with which they were made. Enlargements require a viewing distance equal to the camera lens focal length times the number of diameters of enlargement. This usually results in a viewing distance more convenient to the eye than the one most desirable for contact prints, which is rarely practical, with the result that enlargements seem to convey an improvement in naturalness. For pictures projected on a screen, the correct viewing distance is equal to projector-screen distance multiplied by the ratio of the focal length of the taking lens to that of the projection lens. It is natural, however, to view any picture at a distance convenient to the eye when looking at it as a whole. Only if this results in a departure by more than a factor of 2 from the correct viewing distance is the rendering of perspective noticeably affected.

The best balance between normal perspective in the picture and compact still-camera design calls for a focal length slightly greater than the picture diagonal. Lenses with a focal length shorter than this are known as wide angle, while long-focus lenses, such as the telephoto type, exceed the diagonal considerably in focal length.

## LENS DIAPHRAGM AND ITS MARKINGS

While slower lenses have a fixed opening or a series of apertures in a movable slide or disk, faster lenses have an adjustable opening to vary the amount of light passed. The size of this opening is indicated by a diaphragm scale, generally marked in  $f$ -numbers. Each  $f$ -number is the focal length divided by the effective diameter of the diaphragm. These numbers are related to light intensity at the image plane and permit common exposure recommendations for lenses of all focal lengths. The  $f$ -numbers 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32 indicate successive decreases of one half in light intensity. For an average lens at  $f/8$ , the illumination of the image in foot-candles is about  $1/700$  of the subject brightness in foot-lamberts.

Until recently the U. S. (Uniform System) markings in which the numbers are proportional to the exposure required were used on a number of lenses. The U.S. markings compare with the  $f$ -values as follows:

$f$	$f/4$	$f/5.6$	$f/8$	$f/11$	$f/16$	$f/22$	$f/32$	$f/45$
U.S.			4	8	16	32	64	128

**Effective  $f$ -Number for Extreme Close-Ups:** In making extreme close-ups, the image distance no longer approaches the focal length; hence the *effective  $f$ -number* will be higher than indicated. This is especially important in color photography and in copying. The formula for computing the effective  $f$ -number is given on page 32, or the exposure modification can be determined with the *Kodak Lens Guide*, sold by Kodak dealers.

## CORRECTIONS IN PHOTOGRAPHIC LENSES

A single convergent lens can be used to form an image, which will, however, be found to suffer from serious defects due to lens aberrations, especially when used at full aperture. Kodak lens designers and lens makers use every means known to optical science to eliminate these aberrations entirely, or reduce them to a degree consistent with good performance. Some of the inherent shortcomings of lenses which are corrected in Kodak objectives, to make them meet the exacting demands of modern photography, are briefly listed. Those interested in further details should consult a good textbook on optics.

**Spherical Aberration:** In the case of a simple lens with spherical surfaces, the rays coming through the central portion of the lens and the rays coming through an outer zone do not converge at the same distance from the lens. As a result a point is imaged as a blur. The aberration is due to the fact that spherical surfaces are used on the lens, and is therefore called "spherical aberration." The effect of a small amount of this aberration on the image of an extended subject is to cover it with a haze of light. If present in large amounts, spherical aberration will spoil the sharpness and crispness of definition, approximately uniformly over the whole field. As the magnitude of this aberration usually rises rapidly with increased lens aperture, it becomes progressively more troublesome and harder to eliminate as the speed of a lens is increased. (See Figure 1.)

**Coma:** Coma is a kind of lateral spherical aberration. In spherical aberration itself, the various zones of a lens suffer from a longitudinal difference of focus for rays parallel to the lens axis. Coma affects the rays not parallel to the axis. When coma is present, these oblique rays passing through the various zones converge at different distances from the center of the image, so that a single point in the subject is imaged as an arrowhead pointing toward the center of the field.

**Astigmatism:** In this aberration, a single point in the subject is imaged not as a point but as two short, mutually perpendicular lines at different distances from the lens. The distance between the lines is a



measure of the astigmatism present in the lens. Neither coma nor astigmatism exists at the center of the picture or, in other words, on the axis of the lens.

**Curvature of Field:** The field of a lens is the imaginary surface where the image of the subject is brought to focus. The field of a simple lens is not flat, but concave or saucer-shaped. As a result, a flat subject at right angles to the lens axis is brought to focus not in a plane as would be desirable for recording the image on a flat film, but on a concave spherical surface. Curvature of field is present in single-lens cameras, and, in order to provide a satisfactorily sharp image over the entire picture area, the film is placed at the distance for best average focus and a small relative aperture is used to increase definition and depth of focus. In some simple lens cameras, the film is held in a curved position, approximating the concavity of the lens field.

**Distortion:** In the case of distortion, the magnification varies from the center of the picture outward. This results in a distortion of the image

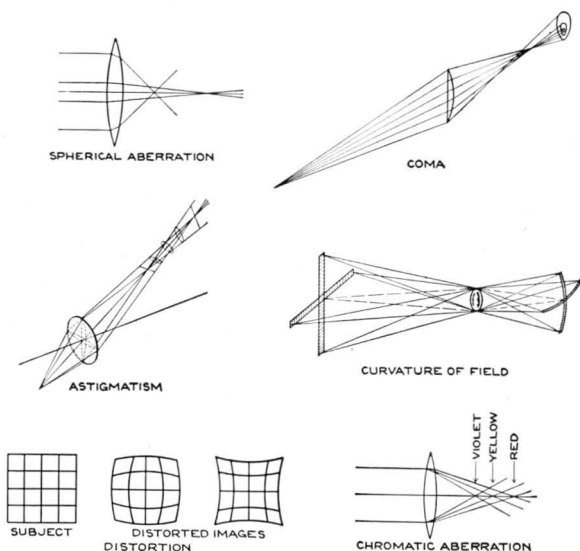


Figure 1—Lens Aberrations. The subject is to the left of the lens, image to the right. All aberrations are shown greatly exaggerated.

and causes a square object to be imaged as either a barrel-shaped or a cushion-shaped figure. When distortion is present, a straight line running across the center of the picture remains straight, but straight lines lying in the outer parts of the image field are bowed.

**Chromatic Aberration:** Because the degree of refraction or bending of a ray of light upon entering or leaving a polished glass surface varies with the color of the light, every property of a lens depends on color. Thus the position of the image itself changes slightly with the color or wave length of light (see Figure 1); this effect is known as axial or longitudinal chromatic aberration. Fortunately, it is possible to reduce this deficiency greatly by using the proper combination of two or more different kinds of glass in a lens.

**Lateral Color:** The varying degrees of refraction of different colors can result in another aberration known as "lateral color" or chromatic difference of magnification. This can occur in a compound lens even though the lens may be corrected for the chromatic aberration as described above. In the case of lateral color, while all the color images may be focused in the same plane, the effective focal length of the lens varies slightly from one color to another; this results in differences in magnification of the respective color images. If present, this aberration results in colored fringes surrounding the images in the outer parts of the field. In black-and-white photography, these colored fringes appear as a slight blur or fuzziness, but in color work, especially if the lens is used in an enlarger, colored fringes may show up very badly. This aberration is not reduced by stopping down the lens.

**Correction of Aberrations:** Corrections are achieved by the use of optical glasses differing in their light-bending and color-spreading powers, by the thickness and curvature of lens elements and the spacing between them. In general, the larger the aperture, the more elements are required for full correction. The task of designing lenses will be realized since various aberrations must be corrected simultaneously with a limited choice of glasses and number of elements.

**Kodak Optical Glasses:** These relatively new glasses are unusual in that they are not made from silica, but rather from compounds of rare elements such as tantalum, tungsten, and lanthanum. These new types have a high light-bending power (refractive index) combined with unusually low spreading of individual colors (dispersion). Such properties permit lens elements which are less steeply curved than those of the older glasses. This, in turn, simplifies and permits a higher degree of correction. These new glasses are now in widespread use and are represented in nearly every recent type of Kodak lens.

## **Lens Performance**

### **DEFINITION AT VARIOUS APERTURES**

The term "definition" refers to the ability of a lens to form a clear image of fine detail. Not even a theoretically perfect lens would be capable of imaging a point source of light as a geometrical point. All practical lenses image such a point as a small blur which changes in character with the change of lens aperture. In addition to reducing speed and increasing the depth of field, decreasing the lens aperture improves definition, as it removes the small amount of haze caused by residual aberrations. This also results in a slight increase in image contrast. As a general rule, the best compromise between maximum definition and speed is made by closing down the diaphragm from wide open about two stops for moderately fast lenses, such as  $f/4.5$ 's, and about three stops for ultrafast lenses.

The wave nature of light sets a limit to the increase in definition as the aperture is closed down. A beam of light passing through an aperture does not continue unchanged, but spreads slightly at the aperture edge in a manner similar to the spreading of water waves after passing through a small opening in a breakwater. The smaller the opening, the greater the spreading. This diffraction may begin to influence definition unfavorably as the minimum aperture is approached. If maximum definition is desired, it may be advisable to use a diaphragm setting one to two stops away from the minimum.

Enlarger lenses used at their smaller lens apertures may limit print definition in extreme enlargements due to the diffraction effect mentioned. This limit is seldom reached in ordinary work.

Good lenses will perform satisfactorily at all stops provided. However, for extremely critical work, especially with ultrafast lenses and those of short focal length, it is well to take into consideration the above two factors influencing definition. In general photographic work, these small changes in performance with varying lens apertures are of little consequence.

### **DEFINITION AND CAMERA TECHNIQUE**

Poor definition and lack of sharpness in negatives are more often due to faults in camera handling, in particular focusing errors and camera motion, than to lens quality.

**Focusing for Visible Light:** As the subject-to-lens distance is reduced the lens-to-image distance has to be increased. With lenses of comparatively short focal length and small aperture as used on Brownies

and inexpensive Kodaks, the depth of field is sufficiently great to cover the range of distance normally used for picture taking. With faster lenses when used at their greater apertures the depth of field is more limited and focusing is necessary. With cameras provided with ground glass or coupled range finder focusing, this operation is simple and exact. Using cameras with scale-focusing requires an ability to estimate distances rather closely. For all close-up work and when working at maximum lens apertures with fast lenses, the distance cannot, as a rule, be estimated with sufficient accuracy, and should therefore be measured by a ruler or with the help of a range finder.

**Focusing for Infrared Light:** Focusing a lens by ground glass, range finder, or distance scale setting, produces sharp pictures only with visible light. Infrared light rays, due to their longer wave length, focus in a different plane from visible light rays. Some focusing scales provide a special focusing mark to be used when taking infrared pictures. For certain Kodak lenses, the correction is given in the specification sheet. These corrections are workable averages. As a general rule, better infrared pictures are obtained if the lens is extended by about  $\frac{1}{4}\%$  of its focal length after it has been focused for visible light. To attain additional sharpness, the diaphragm should be closed down.

**Camera Motion During Exposure:** Small cameras are not held sufficiently steady by the average person for longer than  $\frac{1}{50}$  to  $\frac{1}{100}$  second, nor large hand cameras for longer than  $\frac{1}{25}$  second. At slower shutter speeds the use of a good tripod eliminates camera motion. A shutter speed of  $\frac{1}{50}$  second is recommended for large hand-held cameras, and  $\frac{1}{50}$  or preferably  $\frac{1}{100}$  second for small cameras, if light conditions permit. To release a shutter properly, a s-l-o-w, "trigger squeeze" finger movement should be used without moving the rest of the hand. Holding the breath at the instant of exposure often helps to avoid camera motion.

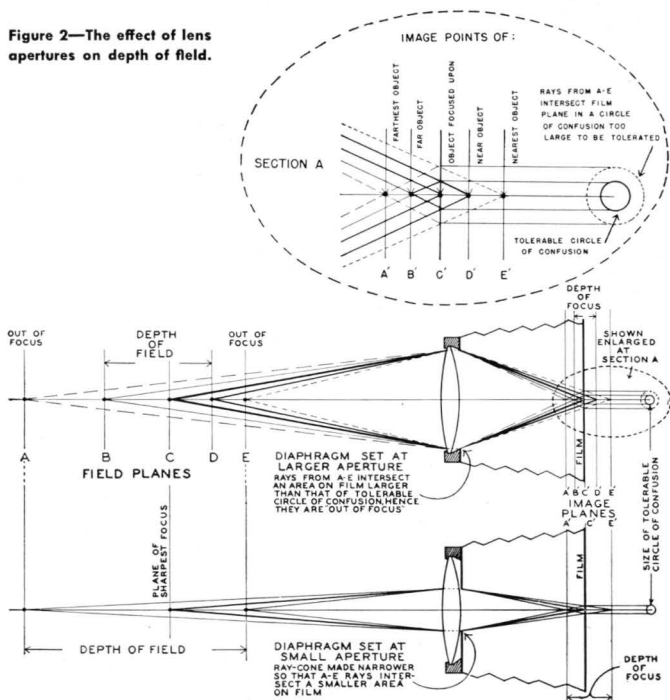
## CIRCLE OF CONFUSION AND DEPTH OF FIELD

Theoretically, when a lens is focused for a certain distance, objects at that distance only are sharp. Objects at all other distances are more or less out of focus, and points outside of the plane focused upon are imaged as blurred circles which are referred to here as "circles of confusion." The farther the points are from the plane focused on, the larger the circles of confusion and the greater the out-of-focus effect. The size of the circle of confusion which appears to the eye as a point and therefore is accepted as tolerable is not a mark of lens quality, but is purely a mathematical value chosen for the purposes of computation.

For critical definition or sharpness, the circle of confusion *in the print* should not be larger than about 1/100 inch, if the print is to be viewed at the normal viewing distance of 10 inches, or, on an angular basis, the circle of confusion should not subtend more than two minutes of arc at the eye when the print is viewed for correct perspective (i.e., viewing distance equal to the focal length of the camera lens times the amount of enlargement, if any). When the circles of confusion exceed these limits, they appear to the eye as small blurs rather than points, and details within the image no longer appear sharp.

“Depth of field” of a lens refers here to the range of distances on the near and far sides of the plane focused upon, within which details are imaged with acceptable sharpness in the final print when observed from a normal viewing distance. Depth of field increases with increasing subject distance, decreases with increasing relative aperture, and increases with decreasing focal length, other things being equal.

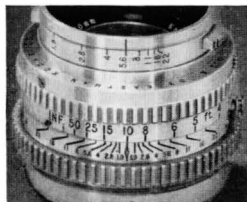
**Figure 2—The effect of lens apertures on depth of field.**



In addition to the factors mentioned above, the depth of field for any lens is dependent upon the size of the circle of confusion which is considered as acceptable. In computing the depth of field for Kodak lenses, a circle of confusion of 1/200 inch is used for folding Kodaks, 1/500 inch for miniature Kodaks, 1/1000 inch for 16-mm. Ciné-Kodaks, and 1/2000 inch for 8-mm. Ciné-Kodaks. For the Kodak lenses intended for commercial, press, portraiture, and studio work, a circle of confusion of 2 minutes of arc which is equal to approximately 1/1720 of the focal length is used in computing the depth of field. This is a smaller circle than is ordinarily used in computing depth of field tables for such lenses and is for critical definition when the print is viewed for normal perspective. At the limits of the range of sharpness, the circles of confusion are of the above dimensions, and between the limits, the circles of confusion are smaller. In the plane focused upon, these circles are a minimum.

Depth of field tables for a number of lenses are in the Lens Specifications. Formulas for computing depth of field are on page 34.

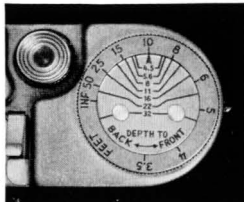
**Depth of Field Indicators:** Some cameras have depth of field indicators which show the approximate depth of field at various distances and lens apertures. The illustration on the left shows a depth of field indicator as part of the focusing scale. At the setting shown it indicates, for example, that at  $f/8$ , subjects from about 7 feet to 19 feet from the camera will be acceptably sharp. The right hand illustration shows an auxiliary type of depth of field indicator. The distance focused upon is brought opposite the index mark and the depth of field can be read off for the various lens openings. Controlled depth of field will help not only to emphasize or subdue fore- and background but also to avoid "wasting" depth of field. The following example will illustrate this: The subject is 50 feet away; exposure conditions call for  $f/11$ . If, instead of focusing at 50 feet, the indicator dial is turned until "infinity" comes to the  $f/11$  line, the index mark is at 22 feet, and the gain in foreground sharpness is an additional 6 feet. The camera is, therefore, focused for 22, not 50 feet.



DEPTH OF FIELD INDICATORS:

← As part of the Focusing Scale.

Auxiliary →  
Type of Indicator.





## LENS PERFORMANCE IN COLOR PHOTOGRAPHY

The ever-increasing interest in color photography has brought more emphasis on the color corrections of photographic lenses. Insufficient lateral color correction, for example, causes color fringing in Kodachrome transparencies, or lack of register in color-separation negatives.

Kodak lenses of recent and present manufacture, according to their intended purposes, are adequately color corrected. The critical user can, however, test any lens for sufficient lateral color correction in the following manner: A test object of white threads should be arranged against a black velvet drop. These threads should be well illuminated, placed to fill the picture area, and critically focused on the camera ground glass. An image of a thread, close to one edge of the ground glass and parallel to that edge, should be examined carefully. If color fringing is apparent, the lens is not satisfactory for exacting color work. Kodachrome transparencies made only for ordinary viewing require less exacting lens performance.

If a lens is to be used for extremely critical work, a more rigorous test can be made photographically with the same subject, as follows: Three exposures should be made on panchromatic plates, such as Kodak Tri-X Panchromatic, Type B, Plates, with Wratten tricolor gelatin filters (cemented or glass filters should not be used for this test). These plates should be developed to low contrast, fixed, washed, and dried, as usual, and a contact positive on glass from one of them made on another plate; the positive also should be developed to a low contrast. This contact positive should be placed emulsion-to-emulsion with each of the other two negatives over an illuminator to see if the thread images coincide exactly. One of the test plates can be used to check the performance of the enlarger lens, if enlarged separation negatives are to be made, by focusing the enlarged image critically on the easel, then examining it for color fringing. If there is only a slight departure from register, definition may nevertheless be satisfactory for many types of work, and the lens can be tried on a typical subject.

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**Kodak Ektars—Left to Right: f/3.3, 35-mm.; f/3.5, 50-mm.; f/1.9, 50-mm.; f/3.5, 90-mm.; f/3.8, 135-mm.; and f/4.5, 153-mm.**



# KODAK LENSES

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KODAK makes a complete line of lenses for still and amateur motion-picture cameras as well as for enlargers, projectors, and other photographic equipment. Here only still-camera and Ciné-Kodak lenses will be described in detail. Data for each lens are given in the Specifications starting on page 35. Summaries of lenses for enlarging and for home-movie and slide projection are shown on pages 51 and 60 respectively.

## KODAK EKTARS

Of the millions of photographers, an increasing number carry out photographic work of a specialized nature. Industry and science are making ever greater use of photography. All this has created a demand for lenses that meet the most exacting requirements. In line with its policy to serve all photographic needs, the Eastman Kodak Company introduced in 1936 the first "Ektar" lens—the beginning of a series of highest quality lenses. Since then, other Ektar lenses have been added so that today there is available a balanced line of Ektar lenses serving practically all needs of the most exacting photographic worker. Kodak Ektars are not intended to replace, but rather to supplement, the long established line of Kodak Anastigmat Lenses, which are made to precise standards and give excellent results both in black-and-white and color.

In the Ektars, designers and lens makers have co-operated in making the best lenses that skill, care, and optical research can produce. For example, astigmatism, which is normally present in small amounts in all lenses, has been reduced in the Ektars to a new minimum. Air-glass surface treatment is applied to all Ektar lenses to reduce flare, and to improve the clarity and brilliance of the image in black-and-white negatives and color purity in Kodachrome transparencies. Color correction has been carried out to such a degree that color pictures made with Ektars not only satisfy the most exacting demands of the advanced color workers, but meet the far stricter requirements encountered when making photomechanical color reproductions.

**Kodak Ektars for Kodak Ektra and Bantam Cameras:** Miniature photography with its specialized technique, its severe demands on the degree of enlargement of negatives, finds in the Kodak Ektar a lens which satisfies these requirements. All the corrections, notably those

which make for greater definition, are carried out to an especially high degree. The numerous lens surfaces necessary for well-corrected high-aperture objectives permit the effective use of lens coating. Ektar lenses for the Kodak Ektra and Bantam Special have treated air-glass lens surfaces.

With interchangeable lenses, the change-over from one lens to another must not only be quick but, above all, precise and positive. To assure exact focus and positive coupling with the range finder, Kodak Ektars for the Ektra are held in precise position against a fixed lens seat by means of a threaded collar with a locking device. The 35- and 50-mm focal length lenses have a unique two-phase focusing scale which permits the minimum focusing limit to be extended from the customary  $3\frac{1}{2}$  feet to 1 foot.

**Kodak Ektars for  $2\frac{1}{4} \times 3\frac{1}{4}$  and  $3\frac{1}{4} \times 4\frac{1}{4}$ " Cameras:** The  $f/3.7$ , 105-mm,  $f/4.5$ , 101-mm, and  $f/4.7$ , 127-mm Ektars are available in Flash Supermatic Shutters for cameras such as the Speed Graphic. The Kodak Medalist has an  $f/3.5$ , 100-mm Ektar. These lenses are of particular interest to the photographer using Kodachrome Professional Film, yet they are equally suitable for black-and-white photography, especially under adverse light conditions or when short exposures are necessary. In resolving power, definition, color correction, and other desirable lens qualities, they attain the very high standard established for all Ektar lenses. The air-glass surfaces of these lenses currently supplied are treated.

**Eastman Ektars for  $5 \times 7$  and  $8 \times 10$ " Cameras:** These  $f/6.3$  lenses, available in 14-inch, 12-inch, 10-inch, and  $8\frac{1}{2}$ -inch focal lengths, and supplied in shutter or barrel, are especially designed for view and studio cameras, such as the Eastman Commercial View Camera Model B (All-Metal  $8 \times 10$ ), and Eastman View Cameras 2D and 33A. They are corrected to a very high degree, especially for transverse chromatic aberrations or lateral color, and are, therefore,

**Kodak Anastigmats  $f/4.5$ , supplied in a variety of focal lengths from  $5\frac{1}{2}$  to 12 inches for commercial, portrait, and press cameras.**



ideally suited to Kodachrome and black-and-white photography. The treatment of the air-glass surfaces improves tone separation in shadows in both black-and-white and color pictures, and improves color saturation in color pictures. Each lens is tested for exact register of the images of the three primary colors.

## **KODAK ANASTIGMATS**

**Kodak Anastigmat  $f/4.5$  Lenses** for commercial, portrait, and press work are available in a variety of focal lengths from  $5\frac{1}{2}$  to 12 inches. They are supplied in barrels or shutters for use on appropriate cameras, such as the Speed Graphic and Graflex. They are highly corrected anastigmats, and their excellence is attested by the popularity they have long enjoyed among leading photographers.

**Kodak Anastigmat Specials** are made in a variety of focal lengths and in relative apertures of  $f/3.5$  and  $f/4.5$  and are supplied on various Kodaks. They are highly corrected and made according to the most reliable optical formulas and to very exact specifications, taking full advantage of recent progress in the optical field.

**Kodak Anastigmats** are well corrected anastigmats manufactured in a variety of focal lengths, and in relative apertures from  $f/3.5$  to  $f/8.8$ . These lenses and the Kodak Anastigmat Specials permit the taking of pictures under unfavorable light conditions or at fast shutter speeds. Kodak Anastigmats, like other large-aperture lenses, require focusing.

## **KODAK ENLARGING LENSES**

A lens which gives excellent results in a camera may not perform equally well as an enlarger lens, especially at low degrees of magnification. Good enlarging lenses are designed to meet the particular requirements of enlarging. They are especially corrected for short subject distances rather than for subjects at considerable distances from the lens. They have to work between flat fields, the flat surface of the paper and the flat negative. Since the usual way of focusing an enlarger lens is by visual inspection of the projected image, the longitudinal chromatic aberrations must be exceptionally well corrected. Enlarger lenses used for the making of color-separation negatives must also be well corrected for lateral color to insure precise register.

The lenses listed on page 51 are expressly designed to produce good enlargements. In Projection Ektars, lateral chromatic aberrations have been corrected to an exceptionally high degree. These lenses are therefore particularly suited for critical color work. They also have click stops which facilitate identifying diaphragm stops in the dark.

## CINE-KODAK LENSES

The superb quality and precision of Kodak lenses are particularly evident when Ciné-Kodak and Kodascope lenses are considered. Due to the relatively small film-image size and the subsequent projection to a screen picture many hundred times enlarged, especially high demands are made on these lenses.

A noticeable difference between a Kodak and a Ciné-Kodak lens is the relatively longer focal length considered as normal for the latter. It is about double the diagonal of the exposed part of the picture frame: for 16-mm. film, 1 inch (25 mm.), and for 8-mm. film,  $\frac{1}{2}$  inch (13 mm.). This longer focal length of the lens narrows the angle of view down to about one-half that of a normal-focal-length lens of a still camera. For viewing home movies on a screen, this narrower angle approaches more closely normal vision for moving objects. Human vision has less tendency to scan when viewing moving objects and consequently has a smaller angle of view than when viewing a still picture.

The narrower angle of view of Ciné-Kodak lenses permits the making of faster lenses at lower cost and with fewer lens elements.

The depth of field for Ciné-Kodak lenses is calculated on the basis of a circle of confusion of  $\frac{1}{1000}$  inch for 16-mm. and  $\frac{1}{2000}$  inch for 8-mm. lenses. The fact that 8-mm. film is normally projected to a higher magnification than 16-mm. accounts for the difference.

Wide-angle and long-focus Ciné-Kodak lenses accomplish the same effects as such lenses on still cameras. The former lenses will be found useful in close quarters when it is desired to include a considerable portion of the subject, and the latter when a relatively large screen image of a distant object is wanted.

All Ciné-Kodak lenses are "Kodak Anastigmats," each one designed, corrected, and made to serve fully the task for which it is intended.

All of them are color corrected and give excellent results with Kodachrome as well as black-and-white film.

All newer interchangeable lenses can be mounted quickly and securely by means of adapters. This permits the use of these lenses

### Ciné-Kodak Lenses

*Front row: f/1.9, 25-mm. lens; lens adapter for Magazine Ciné-Kodak; and f/2.7, 15-mm. lens.*

*Back row: f/4.5, 76-mm.; f/1.6, 50-mm.; f/4.5, 114-mm.; f/2.7, 63-mm.; f/4.5, 152-mm.; and f/2.7, 102-mm. lenses.*



on various Ciné-Kodaks, and on new Ciné-Kodaks of the future. For close-ups with fixed-focus lenses, a Kodak Portrait Attachment is available. For titling, and small-object photography with lenses of normal focal length in focusing mount, Kodak Portra Lenses can be used.

Lenses of 38-mm. and longer focal length have unique two-phase focusing. This feature permits scale focusing for normal distances, and after lifting a plunger or removing a screw, the lens can be extended further for extreme close-ups. Using lens extension tubes gives an image on the film up to 8 times the subject size with 16-mm. and 14 times with 8-mm. Ciné-Kodaks. Making such extreme close-ups requires a camera with a reflex or an accessory focusing finder.

Details about the various Ciné-Kodak lenses, attachment sizes, depth of field, and sizes of field covered, are shown on pages 52 to 59.

### KODAK SUPPLEMENTARY LENSES

Two series of Kodak supplementary lenses are available. They are the Kodak Portra Lenses, 1+, 2+, and 3+ diopters\* and the Kodak Telek Lenses, 1-, 2-, 3-, and 4- diopters. These lenses are supplied as members of the Kodak Combination Lens Attachments, a series of combinable accessories which includes also filters, Pola-Screens, and Lens Hoods. In addition to these, the Kodak Portrait Attachment ( $\frac{3}{4}$  + diopter) is supplied. All these lenses are shaped for best lens correction, and are made and finished in the same manner as anastigmat lenses.

**Kodak Portra Lenses** are positive meniscus lenses and have three general uses.

1. When used with cameras which otherwise cannot focus for subjects closer than  $3\frac{1}{2}$  or 4 feet, the focusing range is brought to about 10 inches (with the 3+ lens) and the field size thereby reduced to about 5 x 7 inches. (See Figure 3.) This permits copying and small-object photography. Such photography otherwise demands a considerably extended bellows.

When the camera is focused, it must be fixed on a steady support. Unless the camera is equipped with a ground glass, focusing *must* be done by careful measurement, and the field covered, as given in the table, can be found roughly by disregarding the finder and sighting along the side of the camera. An alternative method of determining

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\*The power of a lens is often expressed in "diopters." A diopter is by definition  $\frac{1}{\text{Focal length in meters}}$ . Thus, a lens with a focal length of 1 meter (39.4 inches) has a dioptric power of 1. The + sign indicates a positive lens, the - sign indicates a negative lens.



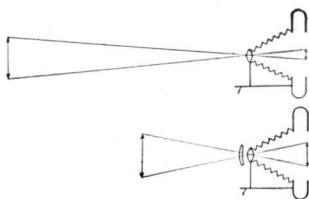


Figure 3. Portra Lens: for close-ups at normal lens-to-film distance.

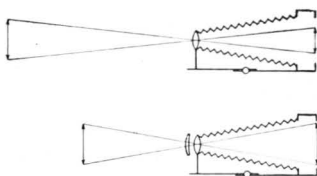


Figure 4. Portra Lens: for larger pictures of small objects at extended lens-to-film distance.

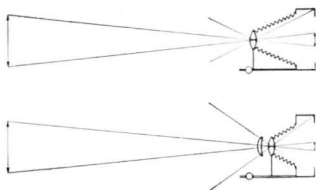


Figure 5. Portra Lens: for wide-angle work at shorter than normal lens-to-film distance.

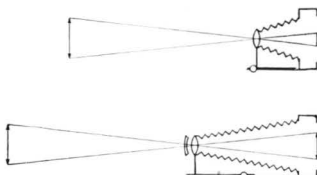


Figure 6. Telek Lens: for larger images of distant subjects at extended lens-to-film distance.

the field is to open the camera back *before loading*, place a sheet of ground glass—matte side toward the lens—in the plane normally occupied by the film, open the shutter, and observe the image.

2. The use of Portra lenses with cameras having double-extension bellows results in larger images of small objects. (See Figure 4.) The image in some cases may be considerably greater in size than the object. The use of the 3+ Portra provides the greatest magnification.

3. Portra Lenses can be used on most cameras of the film-pack type to secure wide-angle effects, since the focal length of the combined camera and Portra Lenses is shorter than that of the camera lens alone. (See Figure 5.) The camera must be focused by means of the ground glass; the camera lens will be back of its usual infinity position. The stronger the supplementary lens, the wider is the angle of view; thus, the 3+ lens gives the widest angle.

**Kodak Portrait Attachments** are low-power ( $\frac{3}{4}+$ ) meniscus lenses, especially suitable for close-up pictures of people. They are available for most Kodaks and for Ciné-Kodaks with fixed-focus lenses.

**Kodak Telek Lenses** are negative meniscus lenses. They can be used only with cameras having double extension bellows or other means

of extending the lens-to-film distance considerably, such as extension backs, extension tubes, etc., and focusing must be done on a ground glass. They make possible low-power telephoto effects and are useful for photographing distant objects and for the making of informal pictures of children, pets, birds, and other subjects when it is impossible or undesirable to take the camera close to the subject. (See Figure 6.) The 4— lens gives the greatest effect.

**Setting the Camera Focusing Scale** for Portra Lenses does not depend on camera lens focal length, but primarily on the subject distance and power of the supplementary lens. The focusing scale settings are given in the table on page 20. They can also be found by the formula on page 33.

**Effective  $f$ -Number:** The Portra Lens reduces the effective focal length of the camera lens. As long as the lens combination is used at the usual lens-to-film distances, the indicated  $f$ -number applies for all general work. When the Portra Lens is used for wide-angle effects, there is a considerable increase in effective lens aperture. However, when the Portra Lens is used for extreme close-ups with extension bellows or backs or when Telek Lenses are employed, there is a considerable decrease in effective lens aperture. In both cases this must be taken into consideration. This can be done conveniently with the *Kodak Lens Guide* or by the formula given on page 32.

**Size of Field** is primarily dependent on subject distance and camera angle of view. It is also affected slightly by the separation between camera and supplementary lens; the values given in the tables are, therefore, approximations. Exact field size should always be found by ground glass focusing methods.

**Depth of Field** when using supplementary lenses is very shallow, a matter of fractions of an inch in many cases. It is, therefore, necessary to measure lens-to-subject distance accurately, and to set the focusing scale correctly. To gain depth of field, the smallest practical aperture should be used. The depth of field at  $f/8$  for minimum and maximum distance settings with Portra Lenses 1+, 2+, and 3+ on lenses of two different focal lengths is shown on the following page.

**Supplementary Lenses and Definition:** A supplementary lens introduces slight aberrations which increase with aperture and focal length of the camera lens and with the power of the supplementary lens. For practical purposes, definition is restored by using small apertures. A supplementary lens should be shielded from side light by a lens hood.

### Subject Distances with Portra Lenses

Distance from Supplementary Lens to Subject in Inches for Kodaks and Ciné-Kodaks

Focusing Scale Set At Feet	Kodak Portrait Attachment	1 + Kodak Portra Lens	2 + Kodak Portra Lens	3 + Kodak Portra Lens
Inf.	52 $\frac{1}{2}$	38 $\frac{1}{4}$	19 $\frac{1}{2}$	13
50	48	37	19	12 $\frac{1}{2}$
25	44	34 $\frac{1}{4}$	18 $\frac{1}{2}$	12 $\frac{1}{4}$
15	40	32	17	12 $\frac{1}{8}$
10	36	29	16	11 $\frac{1}{2}$
8	34	27	16	11
6	30	25 $\frac{1}{2}$	15	11
5	28	23 $\frac{1}{2}$	14	10 $\frac{1}{2}$
4	25	21 $\frac{1}{2}$	14	10
3 $\frac{1}{2}$	23	20 $\frac{1}{2}$	13	10
3	—	18 $\frac{1}{2}$	12	9 $\frac{1}{2}$
2	—	14 $\frac{1}{2}$	10 $\frac{1}{2}$	8 $\frac{1}{2}$

### Optical Data for Kodak Portra Lenses

24 x 36-mm. Camera with 50-mm. Lens	Kodak Portra Lenses		
	1 +	2 +	3 +
DEPTH OF FIELD AT $f/8$			
Distance Scale set at { 3 $\frac{1}{2}$ '	18 $\frac{1}{2}$ " - 22 $\frac{1}{2}$ "	12 $\frac{1}{2}$ " - 14 $\frac{1}{2}$ "	9 $\frac{3}{8}$ " - 10 $\frac{1}{8}$ "
Distance Scale set at { Inf.	32 $\frac{1}{4}$ " - 46 $\frac{1}{2}$ "	17 $\frac{1}{2}$ " - 21 $\frac{1}{2}$ "	12 $\frac{1}{4}$ " - 13 $\frac{3}{8}$ "
APPROX. FIELD SIZE			
Distance Scale set at { 3 $\frac{1}{2}$ '	9 $\frac{1}{2}$ " x 14"	6 $\frac{1}{2}$ " x 9 $\frac{1}{2}$ "	4 $\frac{1}{2}$ " x 6 $\frac{1}{2}$ "
Distance Scale set at { Inf.	18 $\frac{1}{2}$ " x 28"	9 $\frac{1}{2}$ " x 14 $\frac{1}{2}$ "	6 $\frac{1}{4}$ " x 9 $\frac{1}{8}$ "
<b>2<math>\frac{1}{4}</math> x 3<math>\frac{1}{4}</math>-inch Camera with 100-mm. Lens</b>			
DEPTH OF FIELD AT $f/8$			
Distance Scale set at { 3 $\frac{1}{2}$ '	19 $\frac{3}{4}$ " - 21 $\frac{1}{4}$ "	12 $\frac{1}{2}$ " - 13 $\frac{1}{2}$ "	9 $\frac{3}{8}$ " - 10 $\frac{1}{8}$ "
Distance Scale set at { Inf.	34 $\frac{1}{4}$ " - 43 $\frac{1}{2}$ "	18 $\frac{1}{2}$ " - 20 $\frac{1}{2}$ "	12 $\frac{1}{2}$ " - 13 $\frac{3}{8}$ "
APPROX. FIELD SIZE			
Distance Scale set at { 3 $\frac{1}{2}$ '	10 $\frac{1}{2}$ " x 15 $\frac{1}{2}$ "	6 $\frac{1}{2}$ " x 10"	5 $\frac{1}{4}$ " x 7 $\frac{1}{2}$ "
Distance Scale set at { Inf.	22 $\frac{1}{4}$ " x 32 $\frac{1}{2}$ "	11 $\frac{1}{8}$ " x 16 $\frac{1}{4}$ "	7 $\frac{1}{2}$ " x 10 $\frac{1}{4}$ "
<b>16-mm. Ciné-Kodak with 25-mm. Lens</b>			
DEPTH OF FIELD AT $f/8$			
Distance Scale set at { 2'	12 $\frac{3}{4}$ " - 16 $\frac{3}{4}$ "	9 $\frac{3}{8}$ " - 11 $\frac{3}{8}$ "	7 $\frac{3}{8}$ " - 9"
Distance Scale set at { Inf.	*	16 $\frac{1}{8}$ " - 23 $\frac{1}{2}$ "	11 $\frac{1}{4}$ " - 14 $\frac{3}{4}$ "
APPROX. FIELD SIZE			
Distance Scale set at { 2'	4 $\frac{1}{8}$ " x 5 $\frac{1}{2}$ "	3" x 4"	2 $\frac{3}{8}$ " x 3 $\frac{1}{2}$ "
Distance Scale set at { Inf.	*	5 $\frac{1}{4}$ " x 7 $\frac{1}{2}$ "	3 $\frac{1}{4}$ " x 5 $\frac{1}{2}$ "
<b>8-mm. Ciné-Kodak with 13-mm. Lens</b>			
DEPTH OF FIELD AT $f/8$			
Distance Scale set at { 2'	11 $\frac{1}{4}$ " - 19"	8 $\frac{1}{4}$ " - 12 $\frac{1}{2}$ "	7 $\frac{1}{4}$ " - 9 $\frac{3}{4}$ "
Distance Scale set at { Inf.	*	14 $\frac{1}{4}$ " - 28 $\frac{1}{4}$ "	10 $\frac{1}{4}$ " - 16 $\frac{3}{4}$ "
APPROX. FIELD SIZE			
Distance Scale set at { 2'	3 $\frac{1}{8}$ " x 5 $\frac{1}{8}$ "	2 $\frac{1}{4}$ " x 3 $\frac{1}{4}$ "	2 $\frac{1}{8}$ " x 3"
Distance Scale set at { Inf.	*	5" x 6 $\frac{1}{4}$ "	3 $\frac{1}{8}$ " x 4 $\frac{1}{2}$ "

\*There is no advantage in using a Portra Lens 1 + on any of the Ciné-Kodak Lenses when the lens is focused at a distance greater than 4 feet, because the same field size can be obtained by using the regular lens without the Portra Lens 1 +.

## Diffusion Attachments

The Kodak Pictorial Diffusion Disk for cameras is a device which, by means of concentric circles and radial lines polished into its surface, produces a picture made up of a combination of sharp and soft images. The softness produced is desirable in many pictures, such as landscapes.

The Kodak Portrait Diffusion Disk is somewhat similar to the Kodak Pictorial Diffusion Disk in its diffusion effect. It has, in addition, the required optical power ( $\frac{3}{4}$  + diopter) to focus the camera for close-ups.

The Kodak Diffusing Disk is used over the enlarger lens; with it soft-focus prints can be made from sharp-focus negatives. These disks (in three grades for slight, medium, or strong diffusion) are made by polishing a pattern of crossed parallel lines in one face of flat optical glass.

## CARE OF LENSES

For lenses to perform satisfactorily they must be properly aligned with the film, plate, etc. Rough handling or the application of undue force in the use of a camera may upset such alignment and should, therefore, be avoided. If a camera yields consistently imperfect results through no apparent fault of the user, it should be inspected by a reliable dealer and repaired if necessary.

All optical glass should be protected as much as possible from dust, dirt, and fingerprints. Keeping the camera closed when not in use, in the case of a folding model, or the use of a carrying case or lens cap affords some protection. Lenses should also be protected from jars and jolts, and from extreme and sudden temperature changes. They should not be stored in hot or humid places.

An occasional cleaning of all outer lens surfaces—the front as well as the rear—is not only recommended but is necessary for best optical results. Care should be used not to scratch these lens surfaces while cleaning. Any dust or grit should be removed first by gently brushing the surface with wadded Kodak Lens Cleaning Paper or a fine camel's-hair brush. If this brushing action fails to clean the lens, wipe it gently with a wad made from one or several sheets of Kodak Lens Cleaning Paper or a clean, soft, lint-free cloth, such as well-washed linen. Always wipe lightly and with a circular movement. In the case of fingerprints or scum formation, the use of a drop of Kodak Lens Cleaner on the cleaning paper or cloth or breathing on the lens is suggested. Do not use acid, alcohol, and other solvents or harsh, linty cloth. Avoid excessive cleaning and excessive pressure as this may do more harm than good.

**Important:** No attempt should be made to take a lens apart. If the lens or mounting requires attention, it should be returned to the manufacturer.

# KODAK RANGE FINDERS

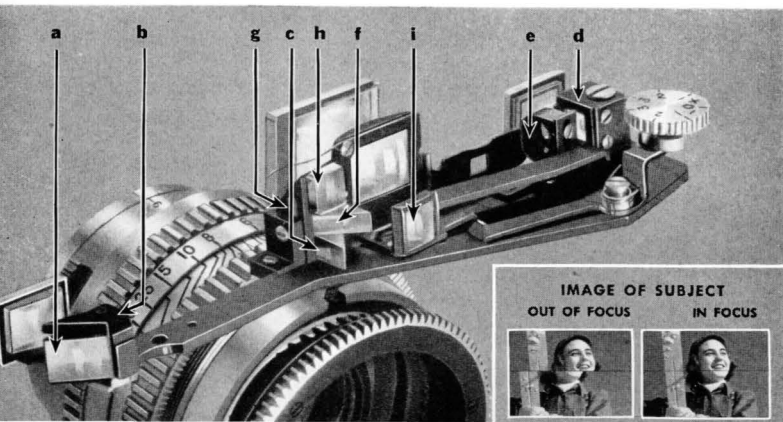
As an aid to accurate focusing, certain Kodaks, such as the Kodak Ektra, the Kodak Medalist, etc., have range finders coupled to the camera lens. For cameras not so equipped, the Kodak Service Range Finder is available. Basically, range finders measure the angle of convergence between two beams of light coming from the same subject point and separated at the camera by the distance between the two apertures of the range finder. The range finder operates by changing the direction of one beam to bring the two beams into alignment in the eyepiece. In coupled range finders, the movable prism or other means for deflecting the one beam of light is linked with the focusing mechanism in such a manner that the lens is focused, at all times, for the point of convergence of the two beams forming the aligned image. The Kodak Service Range Finder contains a scale which translates angle of convergence to linear distance directly. With subject distance thus determined, the camera can be set according to its focusing scale.

The longer the base of the range finder, the greater is its accuracy,

## SPLIT-FIELD, MILITARY TYPE OF RANGE FINDER OF THE KODAK EKTRA

The image of the subject to be focused upon is reflected by fixed prism (a) through lens (b) lower coincidence prism (c) on to the latter's front part where it forms stationary half of the image. The second image of the same subject is reflected through movable prism (d), lens (e), upper coincidence prism (f) on to the latter's front part where it forms movable upper half of the image. The prism (g) erects the inverted image of both halves for normal viewing through collecting lens (h) and eye lens (i). The focusing mount of the camera lens is coupled with the movable prism (d). When both image halves are in alignment, the camera lens is focused on the subject seen aligned in the range finder.

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other things being equal. In cameras for which a range finder of a long physical base is impractical, the effective base is, in some cases, lengthened optically. With lenses of moderate focal length, the depth of field is infinite beyond one hundred feet, and a range finder with a relatively short base has sufficient accuracy.

Ease and speed of aligning the two image halves in the range finder, especially under unfavorable light conditions, depend upon their size and clarity. For this reason, split-field range finders with two clear, brilliant fields showing magnified images of the subject focused on are used extensively by the Navy and Army. All Kodak range finders are of the split-field, military type.

Range finders are an aid to more nearly accurate focusing, and consequently to sharper and crisper pictures. They are, however, especially useful when distances must be determined accurately, for example, in close-up work and when high-speed lenses are used at wide apertures.

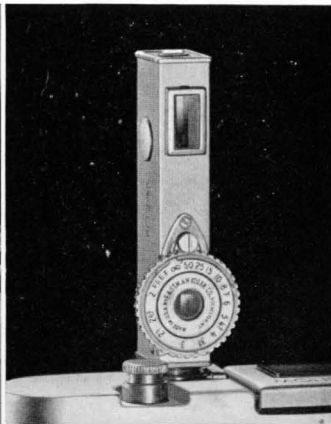
In addition, photographic range finders are useful for measuring other distances when exactness contributes toward better pictures. For example, a range finder can be used in some cases to measure the lamp-to-subject distance in picture taking with artificial light. It can also be used to determine whether near and far objects in the picture are within the depth of field given by indicator or table for a given lens setting.

Good range finders are precision instruments and should be treated as such. All outside glass surfaces should be kept clean. A range finder should never be tampered with, and if it is in need of adjustment, only a competent repairman or the factory should be allowed to do this work.

Close Range and View Finder for Kodak Ektra.



Kodak Service Range Finder.





## COUPLED, SPLIT-FIELD, MILITARY-TYPE KODAK RANGE FINDERS

**On the Kodak Ektra:** The base of the range finder is  $4\frac{1}{8}"$ , the magnification  $2.2\times$ , making it the longest effective range finder base on any  $24 \times 36$  mm. camera. This base assures adequate focusing with telephoto lenses for this camera. Coupling of range finder to all the various lenses is automatic, accurate, and positive. An adjustable eyepiece permits accommodation for differences in eyesight.

**On the Kodak Bantam Special:** The base is  $1\frac{13}{16}"$  and the magnification  $3.1\times$ , ample for the  $f/2$ , 45-mm. lens of this camera. The ocular can be adjusted for individual eyesight.

**On the Kodak Medalist:** The base is  $2\frac{1}{2}"$ —the magnification  $1.5\times$ . When sheet film or film packs are used, range finder and focusing scale are automatically adjusted to the different film plane.

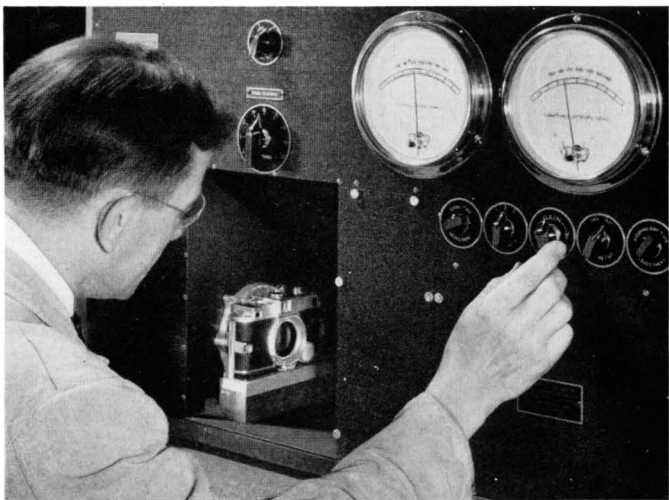
**On the Kodak 35:** The base of this range finder is  $2\frac{5}{16}"$ , unit magnification, sufficiently long for the  $f/3.5$ , 50-mm. lens.

## AUXILIARY, SPLIT-FIELD, MILITARY-TYPE KODAK RANGE FINDERS

**Kodak Service Range Finder:** Inexpensive, small, and sturdy. It measures distance from "Inf." to 2 feet and can be attached to cameras having a suitable clip. Its base is  $1\frac{21}{32}"$  without magnification.

**Close Range and View Finder** for the Kodak Ektra with  $f/1.9$  lens: This range finder is especially designed for measuring distances from  $3\frac{1}{2}$  feet to  $10\frac{1}{2}$  inches. Its base of  $1\frac{1}{2}"$  is, without magnification, sufficient for accurate measurements at this close range.

Kodak shutters are carefully checked for accuracy and efficiency on special electronic testing apparatus.



# KODAK SHUTTERS

INCREASES in lens and emulsion speeds, the use of full-color films, and the greater exactness exercised by photographers have placed emphasis on faster and more accurate shutters.

The scope of a shutter is not determined by the number and range of speeds alone. It is of equal importance that the exposure be sufficiently accurate and consistent at every speed indicated.

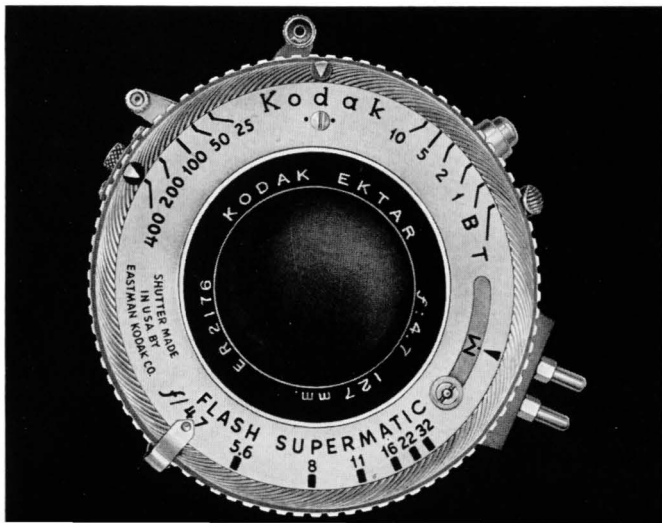
To achieve this in Kodak shutters, physicists and engineers have worked out designs, chemists have tested and selected the most suitable raw materials. For example, shutter and diaphragm blades have a wear-resisting matte black surface coat which reduces danger of lens flare even after years of use. Craftsmen, many of whom were leading watchmakers, have created a timing piece of great accuracy, sturdiness, and efficiency. As in fine watches, base plates are milled and drilled to close tolerances, and gears are cut and scratch-brushed.

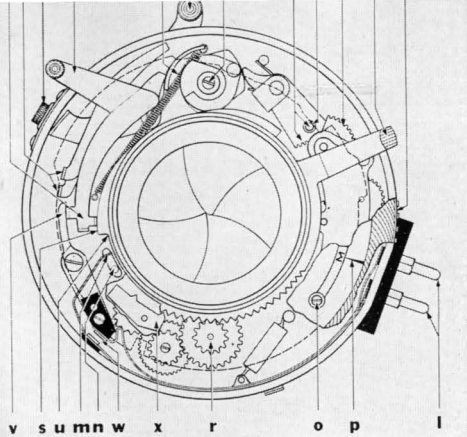
Wholehearted co-operation between designer and craftsman, modern precision manufacturing methods, and more than fifty years' experience in making shutters have created a line of Kodak shutters, each one of which compares favorably with any shutter of similar type and price.

While various means, such as rotating disks, dropping slides, etc., can be used as shutters for still cameras, the most commonly encountered today are between-the-lens and focal-plane shutters.

25

**Kodak Flash Supermatic Shutter with nine speeds ranging from 1 to 1/400 second, built-in synchronization for three flash settings, and blade arrester.**





## KODAK FLASH SUPERMATIC SHUTTER

Presetting the shutter by moving lever (a) to the right sets up tension in spring (b); at 1/400 second additional spring located under eccentric member (c) is brought into action. Shutter speeds are changed by turning speed selecting ring (d) which, by means of cams shown as dashed line, actuates controls. The step-shaped cam at (e) controls extent of engagement of gear sector (f) with one member of gear train retard mechanism (g) and a cam, not shown, controls position of an oscillating pallet relative to a ratchet wheel. "T" and "B" are determined by positions of levers (h), also controlled by a cam. The release lever is marked (i) and the socket for the cable release (k).

Flash discharges with no time lag are synchronized with shutter blade action by an electric circuit formed through

prongs (l) and closing it at (m) through post (n) which moves upward as blades open.

Photoflash lamps with 5 milliseconds time lag are synchronized by sliding "F" on the limiting stop (o) opposite index (p). Clockwise movement of lever (q) sets up spring tension through gear train (r) and moves cam (s) upwards. Downward pressure on lever (i) now allows its extension (t) to move sideways to cam (u). Lever (v) follows and opposite end closes contacts (w). This releases gear train which, through downward movement of step between cams (s and u), actuates lever (t) and releases shutter so blades are fully opened about 5 milliseconds after electric circuit has been closed.

Synchronizing flash lamps with 20 milliseconds time lag is accomplished similarly. Limiting stop (o) at "M" permits extended movement of lever (q) which, in addition to the action described above, engages oscillating pallet (t). The pallet's action slows down counterclockwise travel of "step" and shutter is released so that "fully open" is reached about 20 milliseconds after contacts (w) have closed.

**Between-the-Lens or Central Shutters** open from the center and close toward the center. Exposure time depends upon the speed of opening and closing and the time the shutter remains open. There are two types—the self-setting or automatic, and the presetting shutter. In the former, pressing the release lever first sets up the spring tension and then trips the shutter. Such a design is generally employed on shutters with fewer and slower shutter speeds. In the presetting type of shutter, the necessary spring tension is produced by the separate action of setting or cocking before an exposure can be made. This construction permits not only a greater number, but also faster and more accurate shutter speeds. On most cameras the cocking of the presetting shutter has to be done manually; however, on some cameras, such as Kodak 35, Medalist, etc., advancing the film sets the shutter.

**Focal-Plane Shutters** are curtain types of shutters that operate near, and parallel to, the emulsion surface. The exposure time is regulated

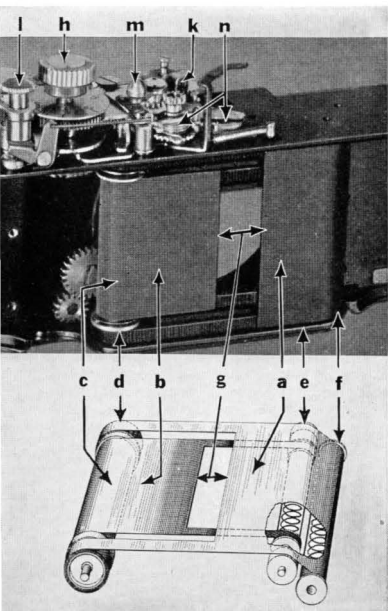
by varying the width of the slit, the time lag between the movement of two curtains, or in some cases, by varying the tension that pulls the curtain. For uniform exposure, it is important that the velocity of the curtains be uniform or that acceleration be compensated for by increasing the width of the slit as it moves across the focal plane.

Either type of shutter has advantages and shortcomings. The central shutter exposes the total film area at one time, whereas the focal-plane shutter, when using a slit, exposes one portion of the film after another. The latter results, in photographs of rapidly moving objects, in a slightly drawn out, contracted, or diagonally distorted image, depending upon the direction of the subject's movement. Central shutters permit synchronization at fast shutter speeds with high-peak, high-intensity flash lamps; whereas focal-plane shutters call for special flash lamps with a plateau type of light output curve.

**Synchronization of Shutters with Flash Lamps:** To assure good synchronization, the time lag of the flash lamp as well as the lag of the shutter has to be considered. In flash lamps, this lag represents the time between the instant the current is applied and the instant the peak or plateau of light intensity is approached. In central shutters, it is the time between the tripping of the shutter and the instant the

#### FOCAL-PLANE SHUTTER OF KODAK EKTRA

Operating the lever on the back of camera first brings edge of curtain (a) over edge of curtain (b), and then winds them together across film aperture onto rollers



(c and d) setting up spring tension in rollers (e and f). Shutter speeds of 1/50 to 1/1000 sec. are determined by width of the curtain opening (g), regulated by knob (h) which turns roller (c) in relation to roller (d). Acceleration is compensated for by widening of slit as it travels across film plane due to difference in diameter of rollers (c and d). Speeds 1 to 1/25 sec. are selected with dial (i) and controlled by an escapement mechanism (k) which varies the delay of curtain (b) after curtain (a) has completed its run. At "B" setting curtain (a) moves across when the shutter release button (l) is pressed down and curtain (b) follows when button is released. Moving self-timer lever (m) in clockwise direction winds up a spring-actuated escapement mechanism (n) which delays automatic tripping of the shutter by 10 to 12 seconds.

shutter blades clear a given lens aperture. In Kodak central shutters of the presetting type, the average time lag is about 4 to 6 milliseconds, and in those of the self-setting type, 8 to 15 milliseconds. These figures include the time interval between pressing the shutter release to the instant the blades start to open, plus the blade opening time. In focal-plane shutters, the time lag important for correct synchronization represents the interval between tripping the shutter and the instant the curtain slit reaches the film area. In the focal-plane shutter of the Kodak Ektra, the average time lag is 15 to 20 milliseconds.

Flash Supermatic Shutters are equipped with a built-in mechanism which can be engaged to close an electrical circuit from 5 to 20 milliseconds before the shutter opens completely for precise synchronization of flash lamps. These shutters also have contacts for flashing Kodatron Speed Lamps electrically at the precise instant the shutter is fully opened.

**Blade-Arrester:** This feature on Kodak Flash Supermatic and Supermatic Shutters used for press- and view-type cameras permits the opening of the shutter blades for focusing purposes at any speed selected, without moving the speed selecting dial to "T" or "B".

**Delayed-Action Release:** Some shutters are equipped with a device that delays the actual tripping of the shutter by about 10 to 12 seconds to allow the person actuating it to get into the picture.

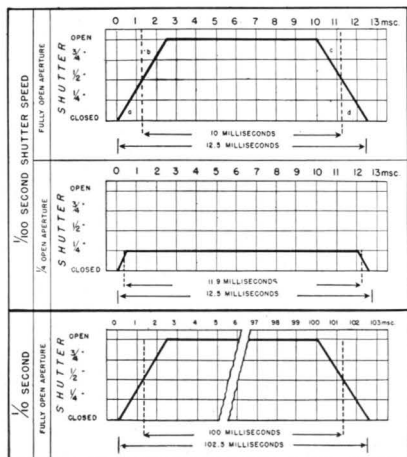
#### EFFICIENCY OF A BETWEEN-THE-LENS SHUTTER AT VARIOUS SPEEDS AND LENS OPENINGS

The top figure shows that out of 12.5 milliseconds, about 2.5 are used for the blades to open fully. About the same time is needed for the blades to close. The shutter permits light to pass the moment the blades begin to open. Light begins to be cut off the moment the blades start to close.

Taking a half-open position as a basis for measuring shutter efficiency compensates for this action, since area (a) is equal to area (b) and area (c) to (d). On this basis the efficiency of the hypothetical shutter illustrated is about 78%.

The middle figure demonstrates that shutter efficiency increases with smaller diaphragm openings. Shutter blades clear a small lens stop in less time than a fully opened one. The shutter efficiency in the case illustrated is about 93%.

The lower illustration shows that shutter efficiency is greater with slower shutter speeds since the time required to open and to close the blades to the half-open position is a smaller percentage of the total time than with faster shutter speeds. At 1/10 of a second and with fully open aperture the efficiency is about 97%.



**Shutter Efficiency:** With between-the-lens or central shutters, efficiency is expressed as a ratio between the actual amount of light permitted to pass and light that would pass if the shutter blades could open and close instantly. An efficiency of 100% is impossible to achieve, since moving blades have to overcome inertia and friction. Kodak shutters of the presetting type open to the maximum diaphragm setting within about two to three milliseconds from the time the blades permit the first ray of light to pass. They close in approximately the same time. Kodak shutters of the self-setting type are somewhat slower and require about six to nine milliseconds. These figures vary somewhat from shutter type to shutter type. They also depend upon the care the shutter has received.

The smaller the diaphragm, the shorter the time used by the shutter blades to clear the lens opening with the result that shutter efficiency increases markedly with smaller lens apertures. Shutter efficiency is greater with longer exposures, since the time for opening and closing represents a smaller percentage of the total shutter operating time.

Shutter efficiency with focal-plane shutters depends upon the distance between shutter curtain and film plane, the width of the slit, and the lens stop used.

Kodak shutters supplied today have been brought to such a degree of mechanical perfection that the unavoidable lowering of efficiency at highest speeds and maximum lens aperture is so small that it will not affect correct exposures even of film with short exposure latitude.

**Shutter Testing:** All Kodak shutters are carefully tested on special machines of the highest precision and must work within strictly held tolerances before they are permitted to leave the factory. While it may be possible to use uncalibrated testers such as rotating disks, etc., to check approximately the speeds on central shutters, such tests do not always give dependable results, especially at the higher speeds, since they do not take into consideration shutter efficiency.

**The Use of Kodak Shutters:** In Kodak central shutters, the speed is selected by moving a lever or by turning a collar on the periphery of the shutter housing. The speeds are varied by means of a step-shaped cam. This type of cam permits the repeating of the same exposure with greater certainty, since the exposure over the whole width of the step is the same. A continuous cam would vary the exposure at the slightest deviation from the exact setting. A step-shaped cam further permits a more accurate calibration of the individual shutter speeds. It does not, however, allow intermediate speeds by setting the index between speed markings.

**Care of Shutters:** Shutters of the presetting and the focal-plane type should not be put aside or stored for long time intervals in a set or cocked position, as this may weaken the spring tension. Avoid jarring or other rough handling, as shutters are fine timing instruments and should be treated as such. Like watches, shutters may have to be checked and cleaned once in a while. This work should be done by a competent repair man or the factory.

## Kodak Shutter Data

### Focal-Plane Shutter of the Kodak Ektra:

B, 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/250, 1/500, 1/1000, and delayed-action release.

### Between-the-Lens or Central Shutters:

#### Presetting Type:

**Flash Supermatic:** T\*, B, 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, 1/400. Built-in device for synchronizing flash lamps and Kodatron flashes.

**Supermatic:** T\*, B, 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, 1/400 (No. 3 no 1/400). Practically all No. 1, 2, and 3 Supermatic shutters have a delayed-action release.

Note: Flash Supermatic and Supermatic Shutters for press, view, and similar cameras are equipped with a blade arrester.

**Kodamatic:** T\*, B, 1/10, 1/25, 1/50, 1/100, 1/200, and delayed-action release.

**Diomatic:** T, B, 1/25, 1/50, 1/100.




#### Self-Setting Type:

**Dakon:** T, B, 1/25, 1/50, 1/100—some models without 1/100.

**Dak:** T (time), B (bulb), I (instantaneous—approx. 1/40 second).

Note: The number preceding or following the shutter name indicates the size of the shutter.

\*On shutters used on cameras with a double exposure prevention device, "T" is omitted.

TABLE OF SHUTTER SPEEDS TO RECORD SUBJECTS IN MOTION			Motion Toward or Away from Camera	Motion at About 45° Angle to Camera	Motion at Right Angles to Camera
Approximate Speed of Subject in miles per hour	Characteristic Subjects	Distance of Subject from Camera			
Proper Shutter Speeds					
5-10	Pedestrians, Slow-moving Animals, Construction Work, Street Activity, Children Playing, Boating	25 ft.	1/100	1/200	1/400
		50 ft.	1/50	1/100	1/200
		100 ft.	1/25	1/50	1/100
20-3	Athletics, Baseball, Yacht Races, Horse Racing, Motorboats, Surf Diving, Views from Trains	25 ft.	1/200	1/400	1/1000
		50 ft.	1/100	1/200	1/400
		100 ft.	1/50	1/100	1/200
60 and up	Auto Races, Motorcycles, Airplanes, Fast Trains	25 ft.	1/400	1/1000	
		50 ft.	1/200	1/400	1/1000
		100 ft.	1/100	1/200	1/400



# USEFUL OPTICAL FORMULAS

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IN THE photography of small objects, in special work with supplementary lenses, and with various projection arrangements, it often happens that the photographer wishes to compute the subject and image positions or sizes, field size, depth of field, etc. A few basic optical formulas are given here to assist in making such calculations.

The usual diagram of the formation of an image by a lens shows rays proceeding in straight lines from points in the subject to corresponding points in the image, as though they passed through a pinhole at the center of the lens. In an actual lens this group of rays may not proceed in straight lines through the center of the lens. Usually, these rays from the subject converge toward one point or apparent pinhole, but after passing through the lens, they diverge apparently from another pinhole or point at a different position on the lens axis. For theoretical accuracy, the subject distance and image distance should be measured from these two points, known as the first and second nodal points. With normal photographic lenses, however, these points are not unduly separated, and the following formulas will apply with practical accuracy if distances are measured to the center of the lens. This approximation does not apply to telephoto lenses in which the principal planes or nodal points may be a considerable distance in front of the lens.

**To Find the Focal Length of a Lens:** The focal length is roughly equal to the distance from the center of the lens to the image plane when the lens is focused for a very distant object. The focal length can be found more accurately by focusing on a small subject, such as a ruler, so that the image is exactly one half the size of the subject. The focal length is then approximately one third of the distance from the subject to the center of the lens.

**To Find the Back Focus of a Lens:** Focus for a very distant object (infinity) and measure the distance between the rear lens surface and the image plane.

## Formulas for approximate position of subject and image:

$f$ = focal length	$u$ = subject distance	$h$ = height of subject
$m$ = magnification	$v$ = image distance	$h'$ = height of image
$x'$ = distance of image from focal point, or distance lens is moved from infinity setting		

The fundamental relation between focal length and image and object distance is: 
$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

More directly useful relations are:

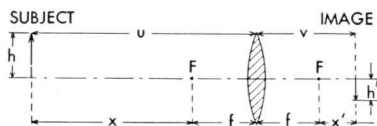
$$\text{Lens to Image: } v = \frac{fu}{u-f} = mu = (m+1)f$$

$$\text{Lens to Subject: } u = \frac{fv}{v-f} = \frac{v}{m} = \left\{ \frac{1}{m} + 1 \right\} f$$

$$\text{Subject to Image: } u + v = \frac{(m+1)^2 f}{m}$$

$$\text{Magnification: } m = \frac{h'}{h} = \frac{v}{u} = \frac{v-f}{f} = \frac{f}{u-f}$$

$$\text{Lens movement from infinity position: } x' = \frac{f^2}{u-f}$$



**Lens-Subject-Image Positions**

These relations hold strictly if the measurements are made from the first and second nodal points. With a normal photographic objective, not a telephoto lens, practical accuracy results if  $u$  and  $v$  are measured from the lens center.

**Effective Aperture for Close-Ups** differs from the indicated aperture because of the increased image distance. This is especially important in work with Kodachrome Film and in copying.

$$\text{Effective } f\text{-number (for any subject distance)} = \frac{v \times f}{f}$$

where  $v$  = lens-to-film distance, or focal length plus lens extension from infinity focus

and  $f$  = indicated  $f$ -number of aperture

and  $f$  = focal length

For close-ups, allow this aperture correction, or increase exposure time by  $v^2/f^2$ .

Both aperture and time corrections are given directly by the *Kodak Lens Guide* for all lenses 1 to 30 inches in focal length.

**Approximate Formulas for Supplementary Lenses**, when the separation between supplementary lens and camera lens is small in comparison with the focal length of the latter. For a negative supplementary lens,  $f_s$  must be treated as a negative value.

$f$  = focal length of camera lens.

$f_s$  = focal length of supplementary lens.

$f_c$  = focal length of the combination.

$$\frac{1}{f_c} = \frac{1}{f} + \frac{1}{f_s}$$

$u$  = distance from supplementary lens to subject.

$v$  = distance from center of camera lens to film.

$m$  = magnification on film (image size/subject size).

$S$  = distance for which camera lens is focused.

$$\text{Lens to Subject: } u = \frac{f_c v}{v - f_c}$$

$$\text{Lens to Image: } v = \frac{f_c u}{u - f_c}$$

$$\text{Magnification: } m = \frac{v}{u} = \frac{f_c}{u - f_c}$$

$$\text{Setting of camera focusing scale: } S = \frac{u f_s}{f_s - u}$$

$$\text{Effective } f\text{-number} = \text{Indicated } f\text{-number} \times \frac{v}{f}$$

When camera lens is set at infinity mark,

$v = f$ ;  $u = f_s$ ; effective  $f$ -number = indicated  $f$ -number.

For very distant objects,

$$v = f_c; \text{ effective } f\text{-number} = \text{indicated } f\text{-number} \times \frac{f_c}{f}$$

**Angle of View:** The angle of view or angular field may mean (1) the diagonal of the picture size, (2) the long, or (3) the short sides of the picture. When a single value is given it usually refers to the angle subtended at the lens by the diagonal of the picture.

$$\text{Angle of view when focused for infinity: } \frac{\frac{1}{2}d}{f} = \tan \Theta$$

$$\text{Angle of view for close-ups: } \frac{\frac{1}{2}d}{v} = \tan \Theta$$

Where:

$d$  = negative dimension (diagonal, or long or short side).

$\Theta$  =  $\frac{1}{2}$  the angle of view.

To find  $\Theta$ , consult a table of trigonometric functions.

**Depth of Field Computations** can be made on the basis of a fixed circle of confusion or on a circle of confusion equal to a fraction of the focal length. When the latter method is used, all lenses of equal effective diameter (not relative aperture) have the same depth of field when the image is viewed at the distance for normal perspective. See the discussion of depth of field, page 9.

*Method A, fixed circle of confusion:*

$f$  = focal length of lens

$f$  =  $f$ -number of relative aperture

$H$  = hyperfocal distance

$$H = \frac{f \times f}{f \times d}$$

$u$  = distance for which camera is focused

$d$  = diameter of circle of confusion

$$\begin{aligned} \text{Near limit of depth of field (measured from camera lens)} &= \frac{H \times u}{H + (u - f)} & \text{Far limit of depth of field (measured from camera lens)} &= \frac{H \times u}{H - (u - f)} \end{aligned}$$

*Method B, circle of confusion a fraction of the focal length of the lens:*

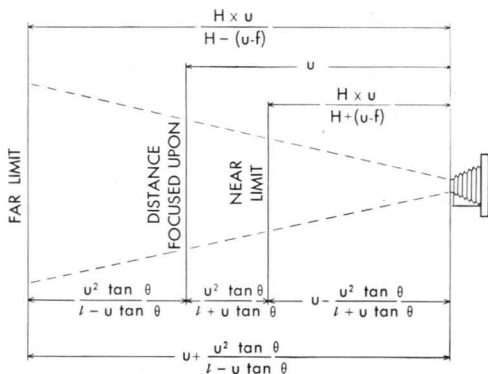
$u$  = distance focused upon

$\Theta$  = angular size of circle of confusion (in cases where critical definition is required, a common value for  $\Theta$  is 2 minutes of arc [ $\tan 2' = .00058$ ], or approximately  $f/1720$ )

$$l = \text{effective diameter of lens} = \frac{f}{f}$$

$$\begin{aligned} \text{Near limit of depth of field (measured from plane focused upon)} &= \frac{u^2 \tan \Theta}{l + u \tan \Theta} & \text{Far limit of depth of field (measured from plane focused upon)} &= \frac{u^2 \tan \Theta}{l - u \tan \Theta} \end{aligned}$$

All distances must be expressed in the same units, such as feet, inches, etc.



**Depth of Field Relations**

# KODAK LENS SPECIFICATIONS

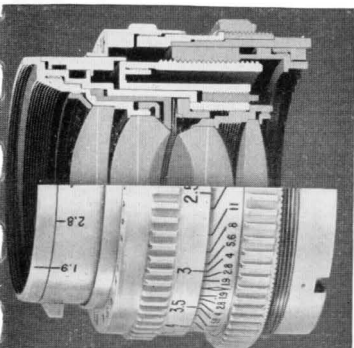
THE following pages contain data intended for use in working with Kodak lenses. Specifications for lenses are given for individual lenses or for groups of lenses of the same basic design.

**Lens Diagrams:** These drawings give a schematic presentation of a given lens design and show the number and approximate arrangement of the various lens elements. Cemented lens elements are shown as joined lens elements. The arrow indicates the direction in which the light normally passes through the lens on its way to the sensitized film. The two vertical lines indicate the approximate location of the lens diaphragm.

**Depth of Field Tables:** Where lack of space does not permit the listing of the depth of field for all aperture stops, the depth of field for the missing *f*-numbers can be approximately ascertained by interpolation.

**Back Focus:** For lenses supplied separately for use in studio, view, press, and reflex cameras, information about the back focus, that is, the distance between the rear-glass surface of the lens and the focal plane when focused at "infinity," is given.

**Attachment Size:** This indicates the size of the Adapter Ring of the Kodak Combination Lens Attachments fitting the lens mount. Adapter Rings listed by *inches* are of the slip-on type, those listed by *number* are of the screw-in type. "Ser. Attachments" indicates the Series number of the attachments fitting this ring.



Kodak Ektar *f*/1.9, 50-mm., with section of lens mount cut away to show number and arrangements of lens elements.

KODAK LENSES 35

## LENS SPECIFICATIONS

LENSES SUPPLIED AS PART OF CAMERA

### KODAK EKTARS

*f*/1.9, 50 mm. • *f*/3.5, 50 mm.  
*f*/3.3, 35 mm. • *f*/3.5, 90 mm.  
*f*/3.8, 135 mm. • *f*/4.5, 153 mm.  
(Kodak Ektra)  
*f*/2.0, 45 mm. (Bantam Special)  
*f*/3.5, 100 mm. (Medalist)

### KODAK ANASTIGMAT SPECIALS

*f*/3.5, 50 mm. (Kodak 35)  
*f*/4.5, 47 mm. (Bantam)  
*f*/4.5, 100 mm., 101 mm., and 127 mm.  
(Monitors and Vigilants)

### KODAK ANASTIGMATS

*f*/4.5, 51 mm. • *f*/5.6, 50 mm.  
(Kodak 35)  
*f*/4.5, 103 mm. and 126 mm.  
(Monitors and Vigilants)  
*f*/6.3, 105 & 130 mm. (Vigilants)

### KODAK EKTARS

*f*/3.7, 105 mm. • *f*/4.5, 101 mm.  
*f*/4.7, 127 mm.

### EASTMAN EKTARS

*f*/6.3, 8½ in. • *f*/6.3, 10 in.  
*f*/6.3, 12 in. • *f*/6.3, 14 in.

### KODAK ANASTIGMATS

*f*/4.5, 5½ in. • *f*/4.5, 6½ in.  
*f*/4.5, 7½ in. • *f*/4.5, 8½ in.  
*f*/4.5, 10 in. • *f*/4.5, 12 in.  
*f*/7.7, 8 in.

LENSES SUPPLIED SEPARATELY

### Table: SUMMARY

### Table: KODAK PROJECTION LENSES FOR ENLARGING

#### KODAK ANASTIGMATS

##### FOR CINÉ-KODAKS 16 MM.

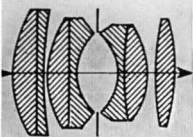
*f*/1.9, 25 mm. • *f*/2.7, 15 mm.  
*f*/3.5, 20 mm. • *f*/3.5, 50 mm.  
*f*/1.6, 50 mm. • *f*/2.7, 63 mm.  
*f*/4.5, 76 mm. • *f*/2.7, 102 mm.  
*f*/4.5, 114 mm. • *f*/4.5, 152 mm.

#### KODAK ANASTIGMATS FOR CINÉ-KODAK EIGHTS

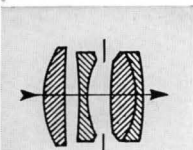
*f*/3.5, 13 mm. • *f*/2.7, 13 mm.  
*f*/2.7, 9 mm. • *f*/1.9, 13 mm.  
*f*/1.9, 25 mm. • *f*/2.5, 38 mm.  
*f*/1.6, 50 mm. • *f*/3.5, 50 mm.  
*f*/2.7, 63 mm. • *f*/2.7, 76 mm.

ENLARGING, CINÉ-KODAK AND PROJECTION LENSES

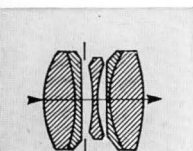
### Table: KODAK LENSES FOR KODASCOPES AND KODASIDE PROJECTORS



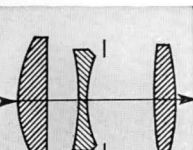
Ektar f/1.9, 50 mm.



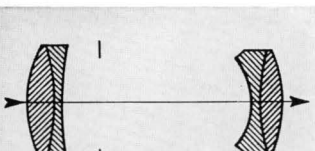
Ektar f/3.5, 50 mm.



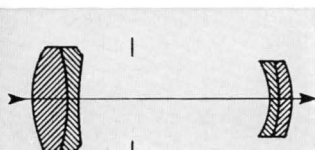
Ektar f/3.3, 35 mm.



Ektar f/3.5, 90 mm.



Telephoto Ektar f/3.8, 135 mm.



Telephoto Ektar f/4.5, 153 mm.

## Specifications:

**KODAK EKTARS f/1.9, 50 mm.; f/3.5, 50 mm.;  
f/3.3, 35 mm.; f/3.5, 90 mm.; f/3.8, 135 mm.;  
f/4.5, 153 mm. (as used on the Kodak Ektra)**

These lenses are entirely new in design. All corrections have been carried out to the high degree so essential for fine photography and especially important for precision miniature work. Particular attention has been given to lateral and longitudinal color corrections. Air-glass surfaces are coated to reduce reflections, thereby improving shadow details and brilliancy in black-and-white negatives and color purity in Kodachrome transparencies. Newly designed precision mounts assure permanent accuracy as well as ease in manipulation. Each lens has an integral depth of field indicator and a focusing mark for infrared film. All lenses are readily interchangeable on the Kodak Ektra, have accurate positioning with respect to the focal plane and to automatic co-ordination with the range finder and parallax correction in the view finder.

**Kodak Ektar f/1.9, 50 mm.** Its high speed and normal focal length meet the requirements of a great range of photography. This lens is especially useful under extremely unfavorable light conditions or when working at maximum shutter speeds.  $F/1.9$  is  $3\frac{1}{2}$  times faster than  $f/3.5$ . Angle of View: When focused for infinity,  $27^\circ \times 40^\circ$ .

Focusing Range: Two-phase scale—Infinity to  $3\frac{1}{2}$  ft., and 3 ft. to  $1\frac{1}{2}$  ft. Attachment Size: No. 24 Adapter Ring and Ser. VI Attachments.

**Kodak Ektar f/3.5, 50 mm.**, is also of normal focal length. The speed is ample to cope with everyday picture opportunities including those with unfavorable light conditions.

Angle of View: When focused for infinity,  $27^\circ \times 40^\circ$ .

Focusing Range: Two-phase scale—Infinity to  $3\frac{1}{2}$  ft., and 3 ft. to  $1\frac{1}{2}$  ft. Attachment Size: No. 25 Adapter Ring and Ser. VI Attachments.

**Kodak Ektar f/3.3, 35 mm.** This wide-angle lens serves outstandingly when it is desired to include a large portion of the subject in the picture; it is especially advantageous when working in close quarters. Due to its shorter focal length this lens has a greater depth of field than the others.

Angle of View: When focused for infinity,  $38^\circ \times 55^\circ$ .

Focusing Range: Two-phase scale—Infinity to  $3\frac{1}{2}$  ft., and 3 ft. to 1 ft. Attachment Size: No. 26 Adapter Ring and Ser. VI Attachments.

**Kodak Ektar f/3.5, 90 mm.** With its moderately long focus, this lens gives large, sharply detailed images of semi-distant subjects and is especially adapted to informal portraiture.

Angle of View: When focused for infinity,  $15^\circ \times 23^\circ$ .

Focusing Range: Infinity to  $3\frac{1}{2}$  ft.

Attachment Size: Ser. V Adapter Ring Insert and Ser. V Attachments or Ser. V-VI Step-up Ring and Ser. VI Attachments.

**Kodak Telephoto Ektar f/3.8, 135 mm.**, is 60% faster than  $f/4.5$  and especially suitable for work under unfavorable light conditions or at high shutter speeds.

Angle of View: When focused for infinity,  $10^\circ \times 15^\circ$ .

Focusing Range: Infinity to 4 feet.

Attachment Size: Ser. VI Adapter Ring Insert and Ser. VI Attachments.

**Kodak Telephoto Ektar f/4.5, 153 mm.**, yields a 15% larger image size than the 135-mm. lens.

Angle of View: When focused for infinity,  $9^\circ \times 13^\circ$ .

Focusing Range: Infinity to 5 ft.

Attachment Size: Ser. VI Adapter Ring Insert and Ser. VI Attachments.

# Lens Data for the Kodak Ektra

## Field Sizes:

## Kodak Ektar Lenses

Lens	Ektar f/1.9, 50 mm.		Ektar f/3.5, 50 mm.		Ektar f/3.3, 35 mm.		Ektar f/3.5, 90 mm.		Telephoto Ektar f/3.8, 135 mm.		Telephoto Ektar f/4.5, 153 mm.	
Distance* to Subject	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.
200 feet	—	—	—	—	—	—	54	80	36	54	32	47
100 feet	—	—	—	—	—	—	27	40	18	27	16	23
50 feet	24	36	24	36	—	—	13 6	20	9	13 6	7 9	11 6
35 feet	—	—	—	—	24	36	—	—	—	—	—	—
25 feet	12	18	12	18	—	—	6 6	10	4 3	6 6	3 9	5 6
15 feet	7 3	10 6	7 3	10 6	10	15	4	6	2 6	3 9	2 3	3 3
10 feet	4 9	7	4 9	7	6 9	10	2 6	3 9	1 7 1	2 5	1 5	2 1
8 feet	3 9	5 6	3 9	5 6	5 6	8	2	3	1 3 3	1 11	1 11	1 7 1
6 feet	2 9	4	2 9	4	4	6	1 6	2 3	11	1 4	9 1	1 1
5 feet	2 3	3 4	2 3	3 4	3 3	5	1 2 1	1 9 1	8 2	1	7 4	10 1
4 feet	1 9	2 8	1 9	2 8	2 9	4	11 1	1 4 1	6	9	—	—
3 1/2 feet	1 6 1/2	2 3 1/2	1 6 1/2	2 3 1/2	2 3	3 4	9 1	1 2	—	—	—	—
3 feet	1 3 1/2	1 11 1/2	1 3 1/2	1 11 1/2	2	3	—	—	—	—	—	—
2 1/2 feet	1	1 6 1/2	1	1 6 1/2	1 7	2 4	—	—	—	—	—	—
2 feet	9 1/2	1 2 1/2	9 1/2	1 2 1/2	1 2 1/2	1 9 1/2	—	—	—	—	—	—
1 1/2 feet	—	—	—	—	1	1 6 1/2	—	—	—	—	—	—
1 1/4 feet	—	6 1/4	—	10 1/4	—	10 1/4	1 3 1/2	—	—	—	—	—
1 1/2 feet	—	—	—	—	8 1/2	1	—	—	—	—	—	—
1 foot	—	—	—	—	6 1/4	—	9 1/4	—	—	—	—	—

## Depth of Field:

## Ektar f/1.9, 50 mm.

Distance* Focused On	DEPTH OF FIELD—IN FEET, Circle of Confusion, 1/500 in.											
	f/1.9		f/2.8		f/4		f/5.6		f/11		f/22	
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	85	inf.	59	inf.	41	inf.	29	inf.	15	inf.	7 6	inf.
50 feet	32	120	27	inf.	23	inf.	19	inf.	11 9	inf.	6 9	inf.
25 feet	19 6	37	17 6	43	15 8	63	13 9	162	9 6	inf.	6	inf.
15 feet	12 9	17 9	12	20	11	23	10	32	7 9	inf.	5 3	inf.
10 feet	9	11 3	8 8	12	8 2	13	7 6	15	6 3	28	4 6	inf.
8 feet	7 4	8 9	7 1	9 2	6 10	9 10	6 5	10 9	5 4	16 4	4	inf.
6 feet	5 8	6 6	5 6	6 7	5 3	6 11	5 1	7 1	4 5	9 6	3 6	25
5 feet	4 9	5 3	4 8	5 4	4 6	5 7	4 4	5 10	3 11	6 6	3 2	13
4 feet	3 10 1/2	4 1 1/2	3 9 1/2	4 3	3 8 1/2	4 4 1/2	3 7	4 6 1/2	3 3	5 3	2 9	7 9
3 1/2 feet	3 4 1/2	3 7 1/2	3 4	3 8	3 3 1/2	3 10	3 2	3 10 1/2	3	4 5	2 6	6
3 feet	2 11 1/2	3 1	2 10 1/2	3 1 1/2	2 10	3 2 1/2	2 9	3 3	2 7	3 7	2 3	4 6
2 1/2 feet	2 4 1/2	2 6 1/2	2 5	2 7	2 4 1/2	2 7 1/2	2 4 1/2	2 8	2 2 1/2	2 10 1/2	2	3 4 1/2
2 feet	1 11 1/2	2	1 11	2	1 11	2 1	1 10 1/2	2 1 1/2	1 9 1/2	2 2	1 8 1/2	2 5 1/2
1 1/2 feet	1 5 1/2	1 6 1/2	1 5 1/2	1 6 1/2	1 5 1/2	1 6 1/2	1 5 1/2	1 6 1/2	1 5	1 7 1/2	1 4 1/2	1 9

The depth is not given for f/8 or f/16. For these two openings see depth on the following table.

## Depth of Field:

## Ektar f/3.5, 50 mm.

Distance* Focused On	DEPTH OF FIELD—IN FEET, Circle of Confusion, 1/500 in.											
	f/3.5		f/4		f/5.6		f/8		f/11		f/16	
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	47	inf.	41	inf.	29	inf.	20	inf.	15	inf.	10	inf.
50 feet	24	inf.	23	inf.	19	inf.	15	inf.	11 9	inf.	8 9	inf.
25 feet	16 6	53	15 8	63	13 9	162	11 6	inf.	9 6	inf.	7 6	inf.
15 feet	11 6	22	11	23	10	32	8 9	55	7 9	inf.	6 1 1/2	inf.
10 feet	8 4	12 6	8 2	13	7 6	15	6 9	18 9	6 3	28	5 3	inf.
8 feet	6 11	9 6	6 10	9 10	6 5	10 9	5 10	12 8	5 4	16 4	4 8	32
6 feet	5 4 1/2	6 9	5 3	6 11	5 1	7 1	4 9	8 2 1/2	4 5	9 6	4	13
5 feet	4 7	5 6	4 6	5 7	4 4	5 10	4 2	6 4	3 11	6 6	3 6	9
4 feet	3 8 1/2	4 4	3 8	4 4 1/2	3 7	4 6 1/2	3 5 1/2	4 10	3 3	5 3	3	6 1 1/2
3 1/2 feet	3 3 1/2	3 9	3 3 1/2	3 10	3 2	3 10 1/2	3 1	4 1 1/2	3	4 5	2 9	5 1
3 feet	2 10 1/2	3 2	2 10	3 2 1/2	2 9	3 3	2 8	3 4 1/2	2 7	3 7	2 5	3 11
2 1/2 feet	2 4 1/2	2 7 1/2	2 4 1/2	2 7 1/2	2 4 1/2	2 7 1/2	2 4 1/2	2 8 1/2	2 2 1/2	2 10 1/2	2 1 1/2	3 1
2 feet	1 11 1/2	2	1 11	2 1	1 10 1/2	2 1 1/2	1 10 1/2	2 1 1/2	1 9 1/2	2 2	1 9	2 4
1 1/2 feet	1 5 1/2	1 6 1/2	1 5 1/2	1 6 1/2	1 5 1/2	1 6 1/2	1 5 1/2	1 6 1/2	1 5	1 7 1/2	1 4 1/2	1 7 1/2

\*Distances are measured from the red focal plane index mark atop the Kodak Ektra.

**Depth of Field:****Ektar f/3.3, 35 mm.**

Distance* Focused On	DEPTH OF FIELD—IN FEET. Circle of Confusion, 1/500 in.											
	f/3.3			f/5.6			f/8			f/11		
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	24 — inf.	14 6	inf.	10 — inf.	8 — inf.	6 3	inf.	5 3	inf.	4 6	inf.	3 9
35 feet	14 6	inf.	10 3	inf.	8 —	6 3	inf.	5 —	inf.	4 6	inf.	3 6
15 feet	9 4	40 —	7 6	inf.	6 3	inf.	5 —	4 —	inf.	3 6	inf.	3 3
10 feet	7 3	17 9	6 —	32 —	5 3	inf.	4 4	inf.	3 6	inf.	2 9	inf.
8 feet	6 —	11 9	5 3	17 6	4 6	36 —	4 —	inf.	3 3	inf.	2 8	inf.
6 feet	4 9	7 9	4 4	10 —	3 9	14 —	3 6	29 —	3 —	inf.	2 6	inf.
5 feet	4 3	6 3	3 9	7 6	3 6	9 6	3 —	14 6	2 9	130 —	2 3	inf.
4 feet	3 6	4 8	3 3	5 4	3 —	6 4	2 9	8 —	2 4	16 —	2 —	inf.
3½ feet	3 1	4 —	2 11	4 6	2 8	5 1	2 6	6 3	2 3	9 10	2 1	35 —
3 feet	2 9	3 4	2 7	3 8	2 5	4 1	2 3	4 9	2 —	6 6	1 10	12 —
2½ feet	2 4	2 9	2 2	2 11	2 1	3 2	2 —	3 6	1 9	4 5	1 8	6 4
2 feet	1 10½	2 1½	1 9½	2 3	1 8½	2 4	1 8	2 7	1 6½	3 —	1 5	3 8
1½ feet	1 8	1 10½	1 7½	1 11	1 6½	2 —	1 6	2 2	1 4½	4 ½	1 3½	2 10
1¼ feet	1 5½	1 6	1 4½	1 7½	1 4½	1 8½	1 3½	1 9	1 3	1 11	1 2½	2 2
1¼ feet	1 2½	1 3½	1 2½	1 4	1 1½	1 4½	1 1½	1 5	1 1½	1 6	1 —	1 7½
1 foot	— 11½	1 —	— 11½	1 —	— 11½	1 —	— 11½	1 1½	— 10½	1 1½	— 10½	1 2½

**Depth of Field:****Ektar f/3.5, 90 mm.**

Distance* Focused On	DEPTH OF FIELD—IN FEET. Circle of Confusion, 1/500 in.											
	f/3.5			f/5.6			f/8			f/11		
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	150 — inf.	94 — inf.	66 — inf.	66 — inf.	48 — inf.	33 — inf.	24 — inf.	20 — inf.	17 6	inf.	12 8	inf.
200 feet	88 — inf.	66 — inf.	50 — inf.	41 — inf.	39 — inf.	29 — inf.	25 — inf.	20 — inf.	18 6	inf.	14 6	inf.
100 feet	62 — 350	50 — inf.	41 — inf.	29 — 210	33 — inf.	25 — inf.	20 — inf.	17 6	inf.	14 6	inf.	12 8
50 feet	38 — 75	33 — 106	29 — 18 4	25 — 11 8	25 — inf.	20 — inf.	17 6	inf.	14 6	inf.	12 8	inf.
25 feet	22 — 29	19 6	13 6	12 4	16 8	13 9	11 8	8 6	12 4	10 6	9 6	37 —
15 feet	13 9	16 8	13 6	8 9	11 8	8 6	7 3	9 —	6 8	5 8	4 4	6 —
10 feet	9 6	10 8	9 —	7 3	9 —	6 8	5 8	5 3	5 3	4 6	3 6	4 6
8 feet	7 8	8 4	7 5½	6 6	6 6	5 5	4 7½	4 6	4 6	3 8	3 9	3 11
6 feet	5 10	6 2½	5 8½	4 8½	4 8½	4 7½	4 6	3 8	3 8	3 3	3 2	3 11
5 feet	4 10½	5 1½	4 9½	3 9½	4 2½	3 9½	3 4	3 8	3 3	3 3	3 2	3 11
4 feet	3 11	4 1	3 10½	3 4½	3 7½	3 4½	3 7	3 4	3 3	3 3	3 2	3 11
3½ feet	3 5½	3 6½	3 4½	3 4½	3 7½	3 4½	3 7	3 4	3 3	3 3	3 2	3 11

The above tables do not give the depth for f/4. For this opening it can be estimated by comparison.

**Depth of Field:****Ektar f/3.8, 135 mm.**

Distance* Focused On	DEPTH OF FIELD—IN FEET. Circle of Confusion, 1/500 in.											
	f/3.8			f/5.6			f/8			f/11		
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	310 — inf.	250 — inf.	150 — inf.	130 — inf.	74 — inf.	54 — inf.	42 — inf.	35 — inf.	26 — inf.	17 6	44 —	—
200 feet	119 — inf.	103 — inf.	85 — inf.	72 — inf.	54 — inf.	42 — inf.	35 — inf.	26 — inf.	17 6	44 —	—	—
100 feet	75 — 148	69 — 176	59 — inf.	52 — inf.	42 — inf.	35 — inf.	26 — inf.	17 6	44 —	—	—	—
50 feet	42 — 59	40 — 65	37 — 75	34 — 90	30 — 148	26 — inf.	17 6	44 —	—	—	—	—
25 feet	23 — 27	22 6	28 —	21 — 32	19 — 36	17 6	44 —	—	—	—	—	—
15 feet	14 5	15 9	14 3	13 5	17 —	12 9	18 4	12 —	20 —	—	—	—
10 feet	9 9	10 4	9 8	10 7	9 4	10 10	9 —	11 3	8 9	11 4	9 —	—
8 feet	7 10	8 2	7 9	8 3	7 6	8 6	7 4	8 9	7 2	9 —	—	—
6 feet	5 10½	6 1½	5 10½	6 1½	5 9	6 3	5 8	6 4	5 6	6 6	—	—
5 feet	4 11½	5 —	4 11½	5 1	4 10½	5 1½	4 10½	5 1½	4 9½	5 2½	4 9	5 5
4 feet	3 11½	4 —	3 11½	4 —	3 10½	4 1½	3 10½	4 1½	3 10½	4 1½	3 10½	4 2

**Depth of Field:****Ektar f/4.5, 153 mm.**

Distance* Focused On	DEPTH OF FIELD—IN FEET. Circle of Confusion, 1/500 in.											
	f/4.5			f/5.6			f/8.0			f/11		
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	335 — inf.	280 — inf.	190 — inf.	138 — inf.	95 — inf.	69 — inf.	52 — inf.	42 — inf.	35 — inf.	26 — inf.	17 6	44 —
200 feet	127 — 500	117 — 755	98 — inf.	85 — inf.	72 — inf.	54 — inf.	42 — inf.	35 — inf.	26 — inf.	17 6	44 —	—
100 feet	78 — 145	75 — 160	67 — 217	59 — 380	50 — inf.	42 — inf.	35 — inf.	26 — inf.	17 6	44 —	—	—
50 feet	43 — 58	42 — 60	40 — 67	37 — 77	33 — 100	30 — 148	26 — inf.	17 6	44 —	—	—	—
25 feet	24 — 27	23 — 27	22 — 28	21 — 32	19 — 36	17 6	44 —	—	—	—	—	—
15 feet	14 4	15 8	14 3½	13 5½	12 9	16 8	13 3	17 4	12 9	18 6	11 4	9 —
10 feet	9 9	10 4	9 8	10 5	9 8	10 6	9 6	10 8	9 3	10 9	9 —	—
8 feet	7 10½	8 1½	7 10	8 2½	7 9	8 3	7 8	8 4	7 6	8 6	7 4	8 9
6 feet	5 11½	6 —	5 11½	6 1	5 10½	6 1½	5 10	6 2	5 9	6 3	5 8	6 4
5 feet	4 11½	5 —	4 11½	5 —	4 10½	5 1	4 10½	5 1	4 10½	5 1½	4 9½	5 2½

\*Distances are measured from the red focal plane index mark atop the Kodak Ektar.



# Close-up and Small Object Photography

## With the Kodak Ektra

The Kodak Ektars  $f/3.3$ , 35 mm.,  $f/3.5$ , 50 mm., and  $f/1.9$ , 50 mm., have two-phase focusing scales which permit close-up work without the use of supplementary lenses to a much greater extent than lenses of similar focal length with only the conventional focusing scale.

Normal focusing extends from "infinity" to  $3\frac{1}{2}$  feet. The coupled range finder measures any distance within this range and the automatic correction for parallax assures that the field seen in the view finder corresponds with the field covered by the lens.

Lifting a plunger releases the focusing sleeve for movement beyond the limit of the normal scale and into a secondary scale engraved in red. This extends the focusing range to  $1\frac{1}{2}$  feet with the 50-mm. Ektars and 1 foot with the 35-mm. Ektra. When using this secondary (red) focusing scale the range finder no longer operates nor does the view finder show any longer exactly the field covered by the lens. Correct focus and size of field can be accurately determined with the aid of the accessory Ground Glass Back.

By using the secondary (red) focusing scale, a field size down to

$6\frac{3}{4}" \times 10\frac{1}{8}"$  with the 50-mm. Ektars set at  $1\frac{1}{2}$  feet

$6\frac{1}{4}" \times 9\frac{1}{4}"$  with the 35-mm. Ektra set at 1 foot

can be obtained. With lenses having only normal focusing scales, such a range of close-ups requires the use of Portra Lenses 1+ and 2+.

If the lens is focused by scale setting, after measuring the subject-camera distance, it is important to remember that the distance scale on the lenses for the Kodak Ektra is based on measurements from the red focal plane index mark atop the camera. This is especially important when making extreme close-ups.

Still smaller fields can be covered by using a Portra Lens 3+ with the 50-mm. Ektars. At the minimum distance setting, the subject will be reproduced on the film about  $\frac{1}{3}$  of its size.

### Data on the Use of a 50-mm. Ektra supplemented by a Kodak Portra Lens 3+

Focusing Scale Set At	Distance * to Subject	DEPTH OF FIELD—IN INCHES								Approximate Size of Field in inches
		Circle of Confusion, 1/500 in. Zone of sharpness extends from the point focused on, at								
		f/8		f/11		f/16		f/22		
		near	far	near	far	near	far	near	far	
INF.	16 <sup>9</sup> / <sub>16</sub> in.	<sup>7</sup> / <sub>8</sub>	1 <sup>3</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>8</sub>	1 <sup>9</sup> / <sub>16</sub>	1 <sup>9</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	3 <sup>5</sup> / <sub>8</sub>	6 <sup>1</sup> / <sub>4</sub> x 9 <sup>3</sup> / <sub>8</sub>
50 feet	16 <sup>1</sup> / <sub>4</sub> in.	<sup>27</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>32</sub>	1 <sup>3</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>2</sub>	2 <sup>11</sup> / <sub>32</sub>	1 <sup>31</sup> / <sub>32</sub>	3 <sup>13</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>8</sub> x 9 <sup>1</sup> / <sub>4</sub>
25 feet	15 <sup>15</sup> / <sub>16</sub> in.	<sup>25</sup> / <sub>32</sub>	1	1 <sup>1</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>32</sub>	1 <sup>7</sup> / <sub>8</sub>	3 <sup>9</sup> / <sub>32</sub>	6 x 9
15 feet	15 <sup>3</sup> / <sub>8</sub> in.	<sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>8</sub>	1	1 <sup>3</sup> / <sub>8</sub>	1 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	1 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>8</sub>	5 <sup>7</sup> / <sub>8</sub> x 8 <sup>3</sup> / <sub>4</sub>
10 feet	15 <sup>3</sup> / <sub>16</sub> in.	<sup>23</sup> / <sub>32</sub>	<sup>7</sup> / <sub>8</sub>	1 <sup>15</sup> / <sub>16</sub>	1 <sup>9</sup> / <sub>32</sub>	1 <sup>9</sup> / <sub>32</sub>	1 <sup>31</sup> / <sub>32</sub>	1 <sup>11</sup> / <sub>16</sub>	2 <sup>13</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>8</sub> x 8 <sup>3</sup> / <sub>8</sub>
8 feet	14 <sup>15</sup> / <sub>16</sub> in.	<sup>11</sup> / <sub>16</sub>	<sup>27</sup> / <sub>32</sub>	<sup>29</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>4</sub>	1 <sup>29</sup> / <sub>32</sub>	1 <sup>15</sup> / <sub>16</sub>	2 <sup>13</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>2</sub> x 8 <sup>1</sup> / <sub>4</sub>
6 feet	14 <sup>1</sup> / <sub>8</sub> in.	<sup>5</sup> / <sub>8</sub>	<sup>25</sup> / <sub>32</sub>	<sup>15</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	1 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>6</sub>	5 <sup>1</sup> / <sub>4</sub> x 7 <sup>7</sup> / <sub>8</sub>
5 feet	14 <sup>1</sup> / <sub>16</sub> in.	<sup>3</sup> / <sub>4</sub>	<sup>23</sup> / <sub>32</sub>	<sup>23</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>3</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>16</sub>	5 x 7 <sup>5</sup> / <sub>8</sub>
4 feet	13 <sup>9</sup> / <sub>16</sub> in.	<sup>9</sup> / <sub>16</sub>	<sup>21</sup> / <sub>32</sub>	<sup>21</sup> / <sub>32</sub>	<sup>31</sup> / <sub>32</sub>	<sup>31</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>2</sub>	1 <sup>9</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>16</sub>	4 <sup>3</sup> / <sub>4</sub> x 7 <sup>1</sup> / <sub>4</sub>
3½ feet	13 <sup>3</sup> / <sub>4</sub> in.	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	<sup>11</sup> / <sub>16</sub>	<sup>3</sup> / <sub>2</sub>	<sup>3</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>2</sub>	1 <sup>3</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>6</sub>	4 <sup>5</sup> / <sub>8</sub> x 7
3 feet	12 <sup>13</sup> / <sub>16</sub> in.	<sup>15</sup> / <sub>32</sub>	<sup>9</sup> / <sub>16</sub>	<sup>5</sup> / <sub>8</sub>	<sup>27</sup> / <sub>32</sub>	<sup>13</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	1 <sup>29</sup> / <sub>32</sub>	4 <sup>1</sup> / <sub>4</sub> x 6 <sup>5</sup> / <sub>8</sub>
2½ feet	12 <sup>3</sup> / <sub>4</sub> in.	<sup>7</sup> / <sub>16</sub>	<sup>1</sup> / <sub>2</sub>	<sup>9</sup> / <sub>16</sub>	<sup>3</sup> / <sub>4</sub>	<sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>32</sub>	1 <sup>3</sup> / <sub>32</sub>	1 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>8</sub> x 6 <sup>1</sup> / <sub>8</sub>
2 feet	11½ in.	<sup>3</sup> / <sub>8</sub>	<sup>7</sup> / <sub>16</sub>	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	<sup>3</sup> / <sub>4</sub>	1	<sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub> x 5 <sup>1</sup> / <sub>2</sub>
1½ feet	10½ in.	<sup>1</sup> / <sub>4</sub>	<sup>11</sup> / <sub>32</sub>	<sup>3</sup> / <sub>8</sub>	<sup>15</sup> / <sub>32</sub>	<sup>1</sup> / <sub>2</sub>	<sup>3</sup> / <sub>4</sub>	<sup>11</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub> x 4 <sup>5</sup> / <sub>8</sub>

\*Distances are measured from the red focal plane index mark atop the Kodak Ektra.

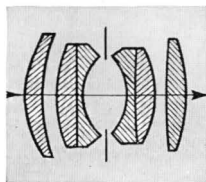
Note: With Kodak Portra Lens 3+, stop  $f/8$  or a smaller opening should be used. The use of a Kodak Portra Lens 3+ with the 35-mm. (wide-angle) Ektra is not recommended for critical work.

## Specifications:

### KODAK EKTAR $f/2.0$ , 45 mm.

(as used on the Kodak Bantam Special)

This Ektar, the fastest lens in a Kodak Bantam camera, is unexcelled in design and performance. It is made and mounted with great precision, factors of special importance with good miniature camera lenses, and highly corrected for all aberrations. Special attention, however, has been given to careful color correction. The air-glass surfaces are treated to reduce internal reflections. This increases shadow detail and brilliance in black-and-white negatives and color purity in Kodachrome transparencies. This lens has a relatively wide angle of view for a lens of this aperture, and due to its short focal length, a great depth of field. An auxiliary focusing mark for infrared film is provided.



**Lens Speed:**  $f/2.0$ , marked apertures— $f/2.0$ ,  $f/2.8$ ,  $f/4$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ , and  $f/16$ .

**Focal Length:** 45 mm.

**Focusing Range:** Infinity to 3 feet, coupled with range finder. Marked distances—infinity, 50, 25, 15, 10, 8, 6, 5, 4,  $3\frac{1}{2}$ , and 3 feet.

**Shutter Speeds:** 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$ ,  $\frac{1}{100}$ ,  $\frac{1}{200}$ ,  $\frac{1}{400}$  sec., T, and B.

**Negative Size:** 28 x 40 mm.

**Angle of View:** When focused for infinity,  $35^\circ \times 48^\circ$ .

**Attachment Size:**  $1\frac{1}{4}$  in., 31.5 mm., Ser. VI Attachments except Lens Hood—use Lens Hood Ser. VIA.

## Working Distance and Field Size with Kodak Portra Lenses

Camera Focus Scale at	Portra Lens 1+		Portra Lens 2+		Portra Lens 3+	
	Distance Subject to Lens	Approximate Field Size	Distance Subject to Lens	Approximate Field Size	Distance Subject to Lens	Approximate Field Size
INF.	$38\frac{1}{2}$ in.	$24\frac{1}{8} \times 34\frac{1}{8}$ in.	$19\frac{1}{2}$ in.	$12\frac{1}{2} \times 17\frac{1}{2}$ in.	13 in.	$8\frac{1}{2} \times 11\frac{1}{2}$ in.
50 feet	$37\frac{1}{2}$ in.	$23 \times 32\frac{1}{2}$ in.	$19\frac{1}{2}$ in.	$11\frac{1}{2} \times 16\frac{1}{2}$ in.	$12\frac{1}{2}$ in.	$8 \times 11\frac{1}{2}$ in.
25 feet	$34\frac{1}{2}$ in.	$21\frac{1}{2} \times 30\frac{1}{2}$ in.	$18\frac{1}{2}$ in.	$11\frac{1}{2} \times 16\frac{1}{2}$ in.	$12\frac{1}{2}$ in.	$7\frac{1}{2} \times 11$ in.
15 feet	$32\frac{1}{2}$ in.	$20 \times 28\frac{1}{2}$ in.	$17\frac{1}{2}$ in.	$11 \times 15\frac{1}{2}$ in.	$12\frac{1}{2}$ in.	$7\frac{1}{2} \times 10\frac{1}{2}$ in.
10 feet	$29\frac{1}{2}$ in.	$18 \times 26$ in.	$16\frac{1}{2}$ in.	$10\frac{1}{2} \times 14\frac{1}{2}$ in.	$11\frac{1}{2}$ in.	$7\frac{1}{2} \times 10\frac{1}{2}$ in.
8 feet	$27\frac{1}{2}$ in.	$17 \times 24\frac{1}{2}$ in.	$16\frac{1}{2}$ in.	$10 \times 14\frac{1}{2}$ in.	$11\frac{1}{2}$ in.	$7 \times 10$ in.
6 feet	$25\frac{1}{2}$ in.	$15 \times 22\frac{1}{2}$ in.	$15\frac{1}{2}$ in.	$9\frac{1}{2} \times 13\frac{1}{2}$ in.	$11\frac{1}{2}$ in.	$6\frac{1}{2} \times 9\frac{1}{2}$ in.
5 feet	$23\frac{1}{2}$ in.	$14 \times 20\frac{1}{2}$ in.	$14\frac{1}{2}$ in.	$9 \times 12\frac{1}{2}$ in.	$10\frac{1}{2}$ in.	$6\frac{1}{2} \times 9\frac{1}{2}$ in.
4 feet	$21\frac{1}{2}$ in.	$13 \times 18\frac{1}{2}$ in.	$14$ in.	$8\frac{1}{2} \times 12$ in.	$10\frac{1}{2}$ in.	$6\frac{1}{2} \times 8\frac{1}{2}$ in.
$3\frac{1}{2}$ feet	$20\frac{1}{2}$ in.	$12 \times 17\frac{1}{2}$ in.	$13\frac{1}{2}$ in.	$8 \times 11\frac{1}{2}$ in.	10 in.	$6 \times 8\frac{1}{2}$ in.
3 feet	$18\frac{1}{2}$ in.	$11 \times 15\frac{1}{2}$ in.	$12\frac{1}{2}$ in.	$7\frac{1}{2} \times 10\frac{1}{2}$ in.	$9\frac{1}{2}$ in.	$5\frac{1}{2} \times 8\frac{1}{2}$ in.

## Depth of Field:

### Kodak Ektar $f/2.0$ , 45 mm.

Distance Focused On	Approximate Field Size	DEPTH OF FIELD—IN FEET. Circle of Confusion, $\frac{1}{500}$ inch.				
		$f/2.0$	$f/4$	$f/8$	$f/11$	$f/16$
INF.	$35^\circ \times 48^\circ$	65 to inf.	32 to inf.	16 to inf.	12 to inf.	8 to inf.
50 feet	$30\frac{1}{2} \times 42\frac{1}{2}$	28 to inf.	19 to inf.	$12\frac{1}{2}$ to inf.	$9\frac{1}{2}$ to inf.	7 to inf.
25 feet	$15\frac{1}{2} \times 22\frac{1}{2}$	18 to 40	14 to 106	10 to inf.	8 to inf.	6 to inf.
15 feet	$9\frac{1}{2} \times 13\frac{1}{2}$	12 to 19	10 to 27	8 to inf.	$6\frac{1}{2}$ to inf.	$5\frac{1}{2}$ to inf.
10 feet	$6\frac{1}{2} \times 8\frac{1}{2}$	8 to 12	7 to 14	$6\frac{1}{2}$ to 25	$5\frac{1}{2}$ to 62	$4\frac{1}{2}$ to inf.
8 feet	$4\frac{1}{2} \times 6\frac{1}{2}$	7 to 9	6 to 10	$5\frac{1}{2}$ to 15	$4\frac{1}{2}$ to 24	4 to inf.
6 feet	$3\frac{1}{2} \times 5\frac{1}{2}$	5 to 6	5 to 7	$4\frac{1}{2}$ to 9	4 to 12	$3\frac{1}{2}$ to 24
5 feet	$3 \times 4\frac{1}{2}$	4 to 5	4 to 6	$3\frac{1}{2}$ to 7	$3\frac{1}{2}$ to $8\frac{1}{2}$	$3\frac{1}{2}$ to 13
4 feet	$2\frac{1}{2} \times 3\frac{1}{2}$	3 to 4	3 to 4	$3\frac{1}{2}$ to 5	3 to 6	$2\frac{1}{2}$ to 8
$3\frac{1}{2}$ feet	$2\frac{1}{2} \times 3$	3 to 3	3 to 4	2 to 4	$2\frac{1}{2}$ to 5	$2\frac{1}{2}$ to 6
3 feet	$1\frac{1}{2} \times 2\frac{1}{2}$	2 to 3	2 to 3	2 to 3	$2\frac{1}{2}$ to 4	$2\frac{1}{2}$ to 5

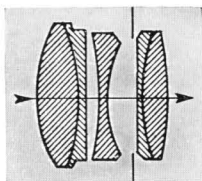
The depth is not given for  $f/2.8$  or  $f/5.6$ . For these two openings depth can be estimated.

## Specifications:

### KODAK EKTAR $f/3.5$ , 100 mm.

(as used on the Kodak Medalist)

This lens is a new addition to Kodak's line of highest-grade precision lenses, which under the name of "Ektar" have won the acclaim of the really exacting and discriminating photographer. With its fast maximum aperture of  $f/3.5$ , this lens brings to photographic workers preferring larger negative sizes many of the picture-taking possibilities up to now restricted to miniature cameras. A carefully worked out formula, superior quality of the carefully chosen optical glass from which each one of the 5 elements is made, precision grinding, polishing, and mounting, all contribute to make it a really outstanding lens. Aberrations, especially those in any way affecting excellent color reproduction, are virtually non-existent. Greater clarity and brilliance of black-and-white negatives and also color purity in case of full-color pictures are assured by treating the air-glass surfaces of the lens. A coupled range finder and an automatic depth of field indicator aid in exact focusing. An auxiliary infrared focusing mark is provided.



**Lens Speed:**  $f/3.5$ , marked apertures— $f/3.5$ ,  $f/4$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ , and  $f/32$ .

**Focal Length:** 100 mm.

**Focusing Range:** Infinity to  $3\frac{1}{2}$  feet, with coupled range finder. Marked distances: Infinity, 50, 25, 15, 10, 8, 6, 5, 4,  $3\frac{1}{2}$  feet.

**Shutter Speeds:** 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$ ,  $\frac{1}{100}$ ,  $\frac{1}{200}$ ,  $\frac{1}{400}$  sec., B, and delayed-action release.

**Negative Size:**  $2\frac{1}{4} \times 3\frac{1}{4}$  in. and  $6.5 \times 9$  cm.

**Angle of View:** When focused for infinity,  $32^\circ \times 45^\circ$  for  $2\frac{1}{4} \times 3\frac{1}{4}$  in.,  $36^\circ \times 49^\circ$  for  $6\frac{1}{2} \times 9$  cm.

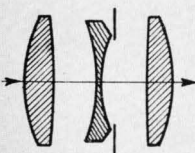
**Attachment Size:** Threaded lens mount accepts Ser. VI Attachments.

### Depth of Field: Kodak Ektar $f/3.5$ , 100 mm.

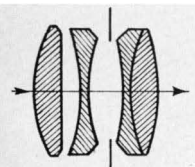
Distance Focused On	Approximate Field Size with $2\frac{1}{4} \times 3\frac{1}{4}$ Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, $\frac{1}{200}$ in.			
		$f/3.5$	$f/4$	$f/5.6$	$f/8$
INF.	$32^\circ \times 45^\circ$	74 to inf.	65 to inf.	46 to inf.	32 to inf.
50 feet	$28' \times 41'$	30 to 155	$28\frac{1}{2}$ to inf.	24 to inf.	$19\frac{1}{2}$ to inf.
25 feet	$14' \times 20'$	19 to 38	18 to 40	16 to 55	14 to 110
15 feet	$8\frac{1}{2}' \times 12\frac{1}{2}'$	12 $\frac{1}{2}$ to 19	12 $\frac{1}{2}$ to 19	11 to 22	10 to 28
10 feet	$5\frac{1}{2}' \times 8'$	8 $\frac{1}{2}$ to 11 $\frac{1}{2}$	8 $\frac{1}{2}$ to 11	8 $\frac{1}{2}$ to 12 $\frac{1}{2}$	7 to 14 $\frac{1}{2}$
8 feet	$4\frac{1}{2}' \times 6\frac{1}{2}'$	7 $\frac{1}{2}$ to 9	7 $\frac{1}{2}$ to 9	6 $\frac{1}{2}$ to 9 $\frac{1}{2}$	6 to 10 $\frac{1}{2}$
6 feet	$3\frac{1}{2}' \times 4\frac{1}{2}'$	5 $\frac{1}{2}$ to 6 $\frac{1}{2}$	5 $\frac{1}{2}$ to 6	5 $\frac{1}{2}$ to 7	5 to 7
5 feet	$2\frac{1}{2}' \times 3\frac{1}{2}'$	4 $\frac{1}{2}$ to 5	4 $\frac{1}{2}$ to 5	4 $\frac{1}{2}$ to 5 $\frac{1}{2}$	4 to 6
4 feet	$2' \times 3'$	3 $\frac{1}{2}$ to 4 $\frac{1}{2}$	3 $\frac{1}{2}$ to 4	3 $\frac{1}{2}$ to 4 $\frac{1}{2}$	3 to 4 $\frac{1}{2}$
$3\frac{1}{2}$ feet	$1\frac{1}{2}' \times 2\frac{1}{2}'$	3 $\frac{1}{2}$ to 3 $\frac{1}{2}$	3 $\frac{1}{2}$ to 3 $\frac{1}{2}$	3 $\frac{1}{2}$ to 3 $\frac{1}{2}$	3 to 4
	Approximate Field Size with $6\frac{1}{2} \times 9$ cm. Neg.	$f/11$	$f/16$	$f/22$	$f/32$
INF.	$36^\circ \times 49^\circ$	23 to inf.	16 to inf.	$11\frac{1}{2}$ to inf.	8 to inf.
50 feet	$32' \times 45'$	16 to inf.	12 to inf.	$9\frac{1}{2}$ to inf.	7 to inf.
25 feet	$16' \times 22'$	12 to inf.	10 to inf.	8 to inf.	6 to inf.
15 feet	$9\frac{1}{2}' \times 13\frac{1}{2}'$	9 to 42	$7\frac{1}{2}$ to inf.	6 $\frac{1}{2}$ to inf.	$5\frac{1}{2}$ to inf.
10 feet	$6\frac{1}{2}' \times 9'$	7 to 17	6 $\frac{1}{2}$ to 26	$5\frac{1}{2}$ to 69	4 $\frac{1}{2}$ to inf.
8 feet	$5' \times 7'$	6 to 12	$5\frac{1}{2}$ to 16	4 $\frac{1}{2}$ to 25	4 to inf.
6 feet	$3\frac{1}{2}' \times 5'$	4 $\frac{1}{2}$ to 8 $\frac{1}{2}$	4 $\frac{1}{2}$ to 10	4 to 13	$3\frac{1}{2}$ to 23
5 feet	$3' \times 4\frac{1}{2}'$	4 to 6 $\frac{1}{2}$	$3\frac{1}{2}$ to 7	$3\frac{1}{2}$ to 9 $\frac{1}{2}$	3 to 13 $\frac{1}{2}$
4 feet	$2\frac{1}{2}' \times 3\frac{1}{2}'$	3 $\frac{1}{2}$ to 4	$3\frac{1}{2}$ to 5	3 to 6 $\frac{1}{2}$	2 $\frac{1}{2}$ to 8
$3\frac{1}{2}$ feet	$2' \times 2\frac{1}{2}'$	3 $\frac{1}{2}$ to 4 $\frac{1}{2}$	3 to 4	$2\frac{1}{2}$ to $5\frac{1}{2}$	$2\frac{1}{2}$ to 6 $\frac{1}{2}$



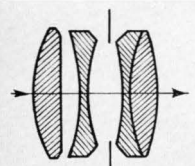
K. A. S. f/3.5, 50 mm.



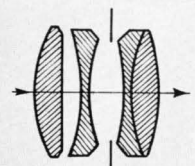
K. A. f/4.5, 51 mm., and f/5.6, 50 mm.



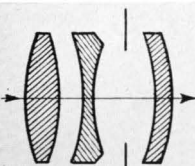
K. A. S. f/4.5, 47 mm.



K. A. S. f/4.5, 100, 101, and 127 mm.



K. A. f/4.5, 103 & 126 mm.



K. A. f/6.3, 105 & 130 mm.

## LENSES ON KODAKS

### KODAK ANASTIGMAT SPECIAL f/3.5, 50 mm. (as used on Kodak 35)

Aperture Range: f/3.5 to f/16. Negative Size: 24 x 36 mm.  
Infrared Focusing: Turn focusing scale counterclockwise by 0.25 in.\*  
Shutter Speeds: 1/10 to 1/200 sec., T, B, and delayed-action release.  
Attachment Size: 1 1/4 in., 31.5 mm., Ser. VI Attachments.

### KODAK ANASTIGMAT f/4.5, 51 mm., and f/5.6, 50 mm. (as used on Kodak 35)

Aperture Range: f/4.5 or f/5.6, respectively, to f/16.  
Infrared Focusing: Turn focusing scale counterclockwise by 0.17 in.\*  
Shutter Speeds: f/4.5 model: 1/25 to 1/150 sec., T, B, and delayed-action release. f/5.6 model: 1/25 to 1/100 sec., T, and B.  
Negative Size: 24 x 36 mm.  
Attachment Size: f/4.5—1 1/4 in., 31.5 mm., Ser. VI Attachments.  
f/5.6—1 5/8 in., 33 mm., Ser. VI Attachments.

### KODAK ANASTIGMAT SPECIAL f/4.5, 47 mm. (as used on Kodak Bantam)

Aperture Range: f/4.5 to f/16. Negative Size: 28 x 40 mm.  
Infrared Focusing: Turn focusing scale counterclockwise by 0.15 in.\*  
Shutter Speeds: 1/25 to 1/200 sec., T, and B.  
Attachment Size: 1 5/8 in., 23.5 mm., Ser. V Attachments.

### KODAK ANASTIGMAT SPECIAL f/4.5, 100 mm., 101 mm., and 127 mm. (as used on Kodak Monitors and Kodak Vigilants)

Aperture Range: f/4.5 to f/32.  
Infrared Focusing: Turn focusing scale counterclockwise by 0.16 in.\*  
Shutter Speeds: 1 to 1/400 sec., T†, B, and delayed-action release.  
Negative Size: 100 mm. and 101 mm.—2 1/4 x 3 3/4 inches. 127 mm.—2 1/2 x 4 1/4 inches.  
Attachment Size: 100 mm.—1 1/4 in., 31.5 mm., Ser. VI Attachments.  
101 mm.—1 5/8 in., 33 mm., Ser. VI Attachments.  
127 mm.—1 1/2 in., 38 mm., Ser. VI Attachments.

### KODAK ANASTIGMAT f/4.5, 103 mm. and 126 mm. (as used on Kodak Monitors and Kodak Vigilants)

Aperture Range: f/4.5 to f/32.  
Infrared Focusing: Turn focusing scale counterclockwise by 0.14 in.\*  
Shutter Speeds: 1/10 to 1/200 sec., T†, B, and delayed-action release.  
Negative Size: 103 mm.—2 1/4 x 3 1/4 inches. 126 mm.—2 1/2 x 4 1/4 inches.  
Attachment Size: 103 mm.—1 1/4 in., 31.5 mm., Ser. VI Attachments.  
126 mm.—1 1/2 in., 38 mm., Ser. VI Attachments.

### KODAK ANASTIGMAT f/6.3, 105 mm. and 130 mm. (as used on Kodak Vigilants)

Aperture Range: f/6.3 to f/32.  
Infrared Focusing: Turn focusing scale counterclockwise by 0.19 in.\*  
Shutter Speeds: 1/25 to 1/100 sec., T, and B.  
Negative Size: 105 mm.—2 1/4 x 3 1/4 inches. 130 mm.—2 1/4 x 4 1/4 inches.  
Attachment Size: 105 mm.—1 1/4 in., 31.5 mm., Ser. VI Attachments.  
130 mm.—1 1/4 in., 31.5 mm., Ser. VI Attachments.

\*This correction from the visual focus represents a working average for distance settings from 8 feet to Infinity.

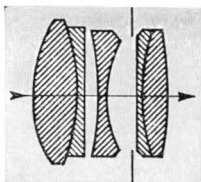
†"T" is omitted on Kodak Monitors.

## 42 KODAK LENSES

## Specifications:

### KODAK EKTAR $f/3.7$ , 105 mm.

This lens has been designed for use on press and similar cameras or the Kodak Precision Enlarger when used as a camera, where excellence of performance and high speed are desired. It has been corrected for all the usual lens aberrations and works equally well at all distance settings from infinity to about  $\frac{1}{2}$  subject size at full lens aperture. It is especially suited for use with Kodachrome film. The performance of this lens, like other Ektars, is unsurpassed by any lens of similar type. The air-glass surfaces are treated. This lens is supplied in Kodak Flash Supermatic Shutter.



**Lens Speed:**  $f/3.7$ , marked apertures— $f/3.7$ ,  $f/4.5$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ , and  $f/32$ .

**Focal Length:** 105 mm. ( $4\frac{1}{8}$  in.), Back Focus 87.5 mm. ( $3\frac{5}{8}$  in.).

**Infrared Focusing:** Extend lens .004 in. (.1 mm.) from visual focus.

**Shutter Speeds:** 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$ ,  $\frac{1}{100}$ ,  $\frac{1}{200}$ ,  $\frac{1}{400}$  sec., T, B, built-in flash synchronization, and blade-arrester.

**Negative Size:**  $2\frac{1}{4} \times 3\frac{1}{4}$  in.

**Angle of View:** When focused for infinity,  $31^\circ \times 43^\circ$ .

**Attachment Size:**  $1\frac{1}{2}$  in., 38 mm., Ser. VI Attachments.

**Depth of Field:** For Critical Definition **Kodak Ektar  $f/3.7$ , 105 mm.**

Distance Focused On	Approximate Field Size with $2\frac{1}{4} \times 3\frac{1}{4}$ Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc. This equals approximately $f/1720$ , and is for critical definition, and when extreme enlargements are to be made from the negatives. For normal work the depth of field is greater.					
		$f/3.7$	$f/5.6$	$f/8$	$f/11$	$f/16$	$f/32$
INF.	$31^\circ \times 43^\circ$	160 to inf.	105 to inf.	74 to inf.	54 to inf.	37 to inf.	18 $\frac{1}{2}$ to inf.
100 feet	$54' \times 78'$	62 to 266	51 to inf.	43 to inf.	35 to inf.	27 to inf.	15 $\frac{1}{2}$ to inf.
50 feet	$27' \times 39'$	38 to 73	34 to 96	30 to 154	26 to inf.	21 to inf.	13 $\frac{1}{2}$ to inf.
25 feet	$13\frac{1}{2}' \times 19\frac{1}{2}'$	22 to 30	20 to 33	18 $\frac{1}{2}$ to 38	17 to 46	15 to 77	10 $\frac{1}{2}$ to inf.
15 feet	$8' \times 11'$	13 $\frac{1}{2}$ to 16 $\frac{1}{2}$	13 to 17 $\frac{1}{2}$	12 $\frac{1}{2}$ to 18 $\frac{1}{2}$	11 $\frac{1}{2}$ to 21	10 $\frac{1}{2}$ to 25	8 $\frac{1}{2}$ to 79
10 feet	$5\frac{1}{2}' \times 7\frac{1}{2}'$	9 $\frac{1}{2}$ to 10 $\frac{1}{2}$	9 $\frac{1}{2}$ to 11	8 $\frac{1}{2}$ to 11 $\frac{1}{2}$	8 $\frac{1}{2}$ to 12 $\frac{1}{2}$	7 $\frac{1}{2}$ to 13 $\frac{1}{2}$	6 $\frac{1}{2}$ to 22
8 feet	$4\frac{1}{2}' \times 6'$	7 $\frac{1}{2}$ to 8 $\frac{1}{2}$	7 $\frac{1}{2}$ to 8 $\frac{1}{2}$	7 $\frac{1}{2}$ to 8 $\frac{1}{2}$	7 to 9	6 $\frac{1}{2}$ to 10 $\frac{1}{2}$	5 $\frac{1}{2}$ to 14
6 feet	$3\frac{1}{2}' \times 4\frac{1}{2}'$	5 $\frac{1}{2}$ to 6 $\frac{1}{2}$	5 $\frac{1}{2}$ to 6 $\frac{1}{2}$	5 $\frac{1}{2}$ to 6 $\frac{1}{2}$	5 $\frac{1}{2}$ to 6 $\frac{1}{2}$	5 to 7	4 $\frac{1}{2}$ to 8
5 feet	$3' \times 3\frac{1}{2}'$	4 $\frac{1}{2}$ to 5 $\frac{1}{2}$	4 $\frac{1}{2}$ to 5 $\frac{1}{2}$	4 $\frac{1}{2}$ to 5 $\frac{1}{2}$	4 to 5 $\frac{1}{2}$	4 $\frac{1}{2}$ to 5 $\frac{1}{2}$	4 to 6 $\frac{1}{2}$
4 feet	$2\frac{1}{2}' \times 2\frac{1}{2}'$	4 to 4	3 $\frac{1}{2}$ to 4	3 $\frac{1}{2}$ to 4	3 $\frac{1}{2}$ to 4	3 $\frac{1}{2}$ to 4	3 $\frac{1}{2}$ to 5
3 $\frac{1}{2}$ feet	$1\frac{1}{4}' \times 2'$	3 $\frac{1}{2}$ to 3 $\frac{1}{2}$	3 $\frac{1}{2}$ to 3	3 $\frac{1}{2}$ to 3	3 $\frac{1}{2}$ to 3	3 $\frac{1}{2}$ to 3	3 to 4 $\frac{1}{2}$

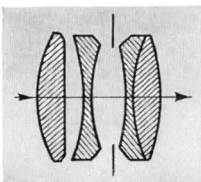
The depth is not given for  $f/4.5$  or  $f/22$ . For these openings it can be estimated by comparison.

## Specifications:

### KODAK EKTAR $f/4.5$ , 101 mm. and $f/4.7$ , 127 mm.

These two lenses make available to the users of small and medium sized press and similar cameras the optical pre-eminence represented by Kodak Ektar Lenses. Their ability to meet most exacting requirements in black-and-white and color photography is well known. Both lenses have treated, air-glass surfaces.

They produce definition of exceptional quality at all apertures and all working distances from infinity to about fourfocal lengths from the lens.



At this distance the image produced is one-third of the size of the subject. When a closer lens-to-subject distance is used, it is advisable to stop the lens below maximum aperture particularly for work demanding critical definition.

Kodak Ektar  $f/4.5$ , 101 mm. is recommended for negatives up to  $2\frac{1}{4} \times 3\frac{3}{4}$  inches and  $f/4.5$ , 127 mm. for  $3\frac{3}{4} \times 4\frac{1}{4}$ -inch negatives. Both lenses are available in Kodak Flash Supermatic Shutters. They are also supplied with metal lens board for Kodak Precision Enlarger.

#### Lens Speed and Marked Apertures:

Kodak Ektar  $f/4.5$ , 101 mm.— $f/4.5$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ , and  $f/32$ .

Kodak Ektar  $f/4.7$ , 127 mm.— $f/4.7$ ,  $f/5.6$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ , and  $f/32$ .

#### Focal Length:

Kodak Ektar  $f/4.5$ , 101 mm. (4 in.) Back Focus 90 mm.

Kodak Ektar  $f/4.7$ , 127 mm. (5 in.) Back Focus 113 mm.

**Infrared Focusing:** Extend lens .004 in. (.1 mm.) from visual focus for both lenses.

**Shutter Speeds:** 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$ ,  $\frac{1}{100}$ ,  $\frac{1}{200}$ ,  $\frac{1}{400}$  sec., T, B, built-in flash synchronization, and blade-arrester.

#### Negative Sizes and Angle of View, when focused for infinity:

Kodak Ektar  $f/4.5$ , 101 mm.— $2\frac{1}{4} \times 3\frac{3}{4}$  in.  $32^\circ \times 45^\circ$ .

Kodak Ektar  $f/4.7$ , 127 mm.— $3\frac{1}{4} \times 4\frac{1}{4}$  in.  $36^\circ \times 46^\circ$ .

#### Diameter of Lens Board Mounting Hole:

Kodak Ektar  $f/4.5$ , 101 mm.— $1\frac{3}{8}$  in., 35 mm.

Kodak Ektar  $f/4.7$ , 127 mm.— $1\frac{1}{2}$  in., 38 mm.

#### Attachment Sizes:

Kodak Ektar  $f/4.5$ , 101 mm.— $1\frac{1}{4}$  in., 31.5 mm., Ser. VI Attachments.

Kodak Ektar  $f/4.7$ , 127 mm.— $1\frac{1}{2}$  in., 38 mm., Ser. VI Attachments.

**Depth of Field:** For Critical Definition **Kodak Ektar  $f/4.5$ , 101 mm.**

Distance Focused On	Approximate Field Size with $2\frac{1}{4} \times 3\frac{3}{4}$ " Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc. This equals approximately $f/1720$ , and is for critical definition, and when extreme enlargements are to be made from the negatives. For normal work the depth of field is greater.					
		$f/4.5$	$f/5.6$	$f/8$	$f/11$	$f/16$	$f/32$
INF.	$32^\circ \times 45^\circ$	127 to inf.	102 to inf.	72 to inf.	52 to inf.	36 to inf.	18 to inf.
100 feet	$62' \times 100'$	56 to inf.	51 to inf.	42 to inf.	34 to inf.	26 to inf.	15 to inf.
50 feet	$28' \times 41'$	36 to 82	34 to 98	29 to 165	25 to inf.	21 to inf.	13½ to inf.
25 feet	$14' \times 20'$	21 to 31	20 to 33	18½ to 38	17 to 48	15 to 83	10½ to inf.
15 feet	$8' \times 12\frac{1}{2}'$	13½ to 17	13 to 17½	12 to 19	11½ to 21	10½ to 26	8½ to 92
10 feet	$5' \times 8'$	9½ to 11½	9½ to 11	8 to 11½	8½ to 12½	7½ to 14	6½ to 23
8 feet	$4' \times 6'$	7 to 8	7 to 8	7 to 9	7 to 9	6½ to 10½	5½ to 14
6 feet	$3' \times 4'$	5 to 6	5 to 6	5 to 6½	5 to 6½	5 to 6	4 to 8
5 feet	$2' \times 3'$	4 to 5½	4 to 5	4 to 5	4 to 5	4 to 5	4 to 6
4 feet	$2' \times 3'$	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	3 to 5
3½ feet	$1' \times 2'$	3 to 3	3 to 3	3 to 3	3 to 3	3 to 3	3 to 4½

The depth is not given for  $f/22$ . For this opening it can be estimated by comparison.

**Depth of Field:** For Critical Definition **Kodak Ektar  $f/4.7$ , 127 mm.**

Distance Focused On	Approximate Field Size with $3\frac{1}{4} \times 4\frac{1}{4}$ " Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc. This equals approximately $f/1720$ , and is for critical definition, and when extreme enlargements are to be made from the negatives. For normal work the depth of field is greater.					
		$f/4.7$	$f/5.6$	$f/8$	$f/11$	$f/16$	$f/32$
INF.	$36^\circ \times 46^\circ$	152 to inf.	128 to inf.	90 to inf.	65 to inf.	45 to inf.	22 to inf.
100 feet	$65' \times 85'$	60 to 292	56 to inf.	47 to inf.	39 to inf.	31 to inf.	18 to inf.
50 feet	$32' \times 42'$	37 to 74	36 to 82	32 to 113	28 to inf.	24 to inf.	15½ to inf.
25 feet	$16' \times 21'$	22 to 30	21 to 31	19½ to 35	18 to 41	16 to 57	11½ to inf.
15 feet	$9\frac{1}{2}' \times 12\frac{1}{2}'$	13½ to 16½	13½ to 17	12½ to 18	12 to 19½	11½ to 23	9 to 45
10 feet	$6\frac{1}{2}' \times 8\frac{1}{2}'$	9 to 10½	9 to 10	9 to 11½	8 to 11½	8 to 13	7 to 18
8 feet	$5' \times 6'$	7 to 8	7 to 8	7 to 8½	7 to 9	6 to 9½	6 to 12½
6 feet	$3\frac{3}{4}' \times 4'$	5 to 6½	5 to 6	5 to 6	5 to 6	5 to 6	4 to 8
5 feet	$3' \times 3'$	4½ to 5½	4 to 5	4 to 5	4 to 5	4 to 5	4 to 6
4 feet	$2\frac{1}{2}' \times 3'$	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4
3½ feet	$2' \times 2\frac{1}{2}'$	3 to 3	3 to 3	3 to 3	3 to 3	3 to 3	3 to 4

The depth is not given for  $f/22$ . For this opening it can be estimated by comparison.

## Specifications:

**EASTMAN EKTARS  $f/6.3$ ,  $8\frac{1}{2}$  in.;**

**$f/6.3$ , 10 in.;  $f/6.3$ , 12 in.;  $f/6.3$ , 14 in.**

These lenses are intended primarily for making color transparencies with Kodachrome Professional Film or color separation negatives. Although designed especially for color work, their use is by no means limited. They are suitable for all types of photography. When used at maximum aperture, the image size on the ground glass should not be larger than about one-third the subject size. At small apertures these lenses perform satisfactorily for almost all types of work, even at lens-to-subject distances giving about 1 to 1 image size.

These lenses are exceedingly well corrected for all lens aberrations, such as coma, astigmatism, curvature of field, and spherical and chromatic aberration both lateral and longitudinal. The air-glass surfaces are treated by a special process which reduces reflections. This increases shadow detail and brilliance in black-and-white, and color purity in Kodachrome pictures. Under certain conditions, lens treating adds to the effective speed of a lens.

The Eastman Ektars  $f/6.3$  cover at full aperture an angle of  $53^\circ$  and at small stops an angle of  $64^\circ$ . For example, the  $f/6.3$ , 14-inch lens covers adequately the recommended negative size (8 x 10 inches) at maximum aperture with allowance for full use of the rising and falling front and swing back. At apertures below  $f/16$  its  $64^\circ$  covering power permits its use on an 11 x 14-inch camera but without allowance for swing back or rising and falling front.

These four Ektar lenses are available in shutter or in barrel. The use of these lenses for enlarging or projection printing is not recommended.

**Lens Speed:**  $f/6.3$ , marked apertures— $f/6.3$ ,  $f/8$ ,  $f/11$ ,  $f/16$ ,  $f/22$ ,  $f/32$ , and  $f/45$ . In barrel, the diaphragm setting ring has "click" stops. As each marked  $f$ -number passes the index mark, a distinct click is heard and felt.

### Focal Length, Recommended Negative Size, and Angle of View:

Focal Length	Recommended Negative Size	Angle of View When Focused for Infinity
$8\frac{1}{2}$ inches 216 mm.	5 x 7 inches	$33^\circ \times 45^\circ$
10 inches 254 mm.	$6\frac{1}{2} \times 8\frac{1}{2}$ inches	$36^\circ \times 46^\circ$
12 inches 304 mm.	8 x 10 inches	$37^\circ \times 45^\circ$
14 inches 356 mm.	8 x 10 inches	$32^\circ \times 40^\circ$

**Infrared Focusing:** Extend lens after focusing critically for visible light by:

0.008 inch (0.2 mm.) for Eastman Ektar  $f/6.3$ ,  $8\frac{1}{2}$  in.

0.012 inch (0.3 mm.) for Eastman Ektar  $f/6.3$ , 10 in.

0.016 inch (0.4 mm.) for Eastman Ektar  $f/6.3$ , 12 in.

0.031 inch (0.8 mm.) for Eastman Ektar  $f/6.3$ , 14 in.

### Shutter Speeds:

Ektar  $f/6.3$ ,  $8\frac{1}{2}$  in.: 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/150 sec., T, B.

Ektar  $f/6.3$ , 10 and 12 in.: 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100 sec., T, B.

Ektar  $f/6.3$ , 14 in.: 1, 1/2, 1/5, 1/10, 1/25, 1/50 sec., T, B.

### Diameter of Lens Board Mounting Hole:

	in.	mm.
Ektar $f/6.3$ , $8\frac{1}{2}$ in. } in shutter	$2\frac{3}{16}$	55
Ektar $f/6.3$ , 10 in. } or barrel	$2\frac{5}{8}$	67
Ektar $f/6.3$ , 12 in. }	$2\frac{7}{8}$	73
Ektar $f/6.3$ , 14 in. in shutter	$3\frac{3}{8}$	86
Ektar $f/6.3$ , 14 in. in barrel	$3\frac{5}{8}$	81

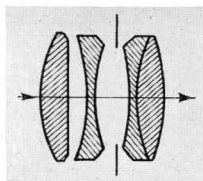
### Attachment Size:

Ektar  $f/6.3$ ,  $8\frac{1}{2}$  in.:  $1\frac{3}{4}$  in., 44.5 mm., Ser. VII Attachments.

Ektar  $f/6.3$ , 10 in.:  $2\frac{1}{8}$  in., 54 mm., Ser. VIII Attachments.

Ektar  $f/6.3$ , 12 in.:  $2\frac{1}{2}$  in., 63.5 mm., Ser. VIII Attachments.

Ektar  $f/6.3$ , 14 in.:  $2\frac{5}{8}$  in., 75 mm. Use Eastman 4-inch Adjustable Filter Holder.



**Depth of Field: For Critical Definition Ektar f/6.3, 8½ in.**

Distance Focused On	Approximate Field Size with 5 x 7" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		f/6.3	f/11	f/16	f/22	f/45
INF.	33° x 45°	193 to inf.	111 to inf.	76 to inf.	55 to inf.	27 to inf.
200 feet	117' x 163'	98 to inf.	71 to inf.	55 to inf.	43 to inf.	24 to inf.
100 feet	58' x 82'	66 to 208	53 to inf.	43 to inf.	36 to inf.	21 to inf.
50 feet	29' x 41'	40 to 68	34 to 91	30 to 146	26 to inf.	18 to inf.
25 feet	14' x 20'	22 to 29	20 to 32	19 to 37	17 to 46	13 to inf.
15 feet	8' x 12'	14 to 16½	13 to 17½	12 to 19	12 to 21	9½ to 34
10 feet	5' x 7½'	9½ to 10½	9 to 11	8 to 11½	8 to 12	7 to 16
8 feet	4' x 6'	7½ to 8½	7 to 8½	7 to 8½	7 to 9½	6 to 11
6 feet	3½' x 4½'	5½ to 6½	5 to 6½	5 to 6½	5 to 6½	5 to 7½
5 feet	2' x 3'	4½ to 5½	4 to 5½	4 to 5½	4 to 5½	4 to 6½
4 feet	2' x 2½'	3½ to 4½	3 to 4½	3 to 4½	3 to 4½	3 to 4½
3½ feet	1½' x 2½'	3½ to 3½	3 to 3½	3 to 3½	3 to 3½	3 to 4

**Depth of Field: For Critical Definition Ektar f/6.3, 10 in.**

Distance Focused On	Approximate Field Size with 6½ x 8½" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		f/6.3	f/11	f/16	f/22	f/45
INF.	36° x 46°	227 to inf.	130 to inf.	90 to inf.	65 to inf.	32 to inf.
400 feet	259' x 339'	146 to inf.	98 to inf.	73 to inf.	56 to inf.	29 to inf.
200 feet	129' x 169'	107 to inf.	79 to inf.	62 to inf.	49 to inf.	27 to inf.
100 feet	65' x 85'	70 to 178	57 to inf.	47 to inf.	39 to inf.	24 to inf.
50 feet	32' x 42'	41 to 64	36 to 81	32 to 113	28 to 214	19 to inf.
25 feet	16' x 21'	22½ to 28	21 to 31	20 to 35	18 to 40	14 to 117
15 feet	9' x 12'	14 to 16½	13 to 17	13 to 18	12 to 20	10 to 28
10 feet	6' x 8'	9½ to 10½	9 to 11	9 to 11½	8 to 12	7 to 14
8 feet	4½' x 6'	7½ to 8½	7 to 8½	7 to 8½	7 to 9½	6 to 10½
6 feet	3½' x 4½'	5½ to 6½	5 to 6½	5 to 6½	5 to 6½	5 to 7½
5 feet	2' x 3'	4½ to 5½	4 to 5½	4 to 5½	4 to 5½	4 to 5½
4 feet	2' x 2½'	3½ to 4½	3 to 4½	3 to 4½	3 to 4½	3 to 4½
3½ feet	1½' x 2½'	3½ to 3½	3 to 3½	3 to 3½	3 to 3½	3 to 4

**Depth of Field: For Critical Definition Ektar f/6.3, 12 in.**

Distance Focused On	Approximate Field Size with 8 x 10" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		f/6.3	f/11	f/16	f/22	f/45
INF.	37° x 45°	273 to inf.	156 to inf.	107 to inf.	78 to inf.	38 to inf.
400 feet	266' x 332'	162 to inf.	112 to inf.	85 to inf.	65 to inf.	35 to inf.
200 feet	133' x 166'	115 to inf.	88 to inf.	70 to inf.	56 to inf.	32 to inf.
100 feet	66' x 83'	73 to 158	61 to 278	52 to inf.	45 to 310	28 to inf.
50 feet	33' x 41'	42 to 61	38 to 74	34 to 94	31 to 139	22 to inf.
25 feet	16' x 20'	23 to 27	21 to 30	20 to 33	19 to 37	15 to 73
15 feet	9½' x 12'	14½ to 16	13½ to 17	13 to 17½	12 to 19	11 to 25
10 feet	6' x 7½'	9½ to 10½	9 to 10½	9 to 11	8 to 12	8 to 14
8 feet	4½' x 5½'	7½ to 8½	7 to 8½	7 to 8½	7 to 8½	6 to 10½
6 feet	3½' x 4½'	5½ to 6½	5 to 6½	5 to 6½	5 to 6½	5 to 7
5 feet	2½' x 3½'	4½ to 5½	4 to 5½	4 to 5½	4 to 5½	4 to 5½
4 feet	2' x 2½'	3½ to 4½	3 to 4½	3 to 4½	3 to 4½	3 to 4½
3½ feet	1½' x 2½'	3½ to 3½	3 to 3½	3 to 3½	3 to 3½	3 to 3½

**Depth of Field: For Critical Definition Ektar f/6.3, 14 in.**

Distance Focused On	Approximate Field Size with 8 x 10" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		f/6.3	f/11	f/16	f/22	f/45
INF.	32° x 40°	318 to inf.	182 to inf.	125 to inf.	92 to inf.	45 to inf.
400 feet	228' x 285'	177 to inf.	125 to inf.	95 to inf.	74 to inf.	41 to inf.
200 feet	113' x 142'	123 to 540	96 to inf.	78 to inf.	63 to inf.	36 to inf.
100 feet	56' x 71'	76 to 146	65 to 220	56 to inf.	48 to inf.	31 to inf.
50 feet	28' x 35'	44 to 59	39 to 69	36 to 84	32 to 110	24 to 574
25 feet	14' x 17'	23 to 27	22 to 29	21 to 31	19 to 34	16 to 61
15 feet	8' x 10'	14½ to 16	14 to 16½	13½ to 17	13 to 18	11 to 23
10 feet	5' x 6½'	9½ to 10½	9 to 10½	9 to 11	9 to 11½	8 to 13
8 feet	3' x 4½'	7½ to 8½	7 to 8½	7 to 8½	7 to 8½	6 to 9½
6 feet	2½' x 3½'	5½ to 6½	5 to 6½	5 to 6½	5 to 6½	5 to 6½
5 feet	2' x 2½'	4½ to 5½	4 to 5½	4 to 5½	4 to 5½	4 to 5½
4 feet	1½' x 2'	3½ to 4½	3 to 4½	3 to 4½	3 to 4½	3 to 4½
3½ feet	1½' x 1½'	3½ to 3½	3 to 3½	3 to 3½	3 to 3½	3 to 3½

The depth is not given for f/8 or f/32. For these openings depth can be estimated by comparison.  
 \*This equals approximately f/1720, and is for very critical definition and when extreme enlargements are to be made from the negatives. For normal work, the depth of field is greater.

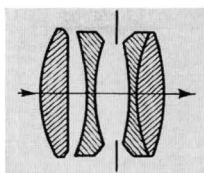


## Specifications:

**KODAK ANASTIGMATS  $f/4.5$ ,  $5\frac{1}{2}$  in.;**

**$f/4.5$ ,  $6\frac{3}{8}$  in.;  $f/4.5$ ,  $7\frac{1}{2}$  in.;**

**$f/4.5$ ,  $8\frac{1}{2}$  in.;  $f/4.5$ , 10 in.;  $f/4.5$ , 12 in.**



These lenses, primarily intended for press, commercial, and studio cameras, are remarkably fine lenses, covering fully the recommended film or plate sizes at their  $f/4.5$  maximum aperture. Every one of them gives very good definition and satisfactory flatness of field. These lenses are recommended for any type of work which requires the fine definition of an anastigmat and are especially suitable for home or studio portraiture, architectural, landscape, and sports photography. Lens corrections are maintained from infinity to about  $\frac{1}{3}$  subject size at  $f/4.5$ . At small stops these lenses perform satisfactorily for most work at even closer range. These lenses are available in barrels, and lenses Nos. 32 to 36 in shutters.

### Focal Length, Negative Size, Angle of View, and Attachment Size:

Lens	Focal Length in inches	Recommended Negative Size inches	Angle of View When Focused for Infinity	in.	Attachment Size mm.	
No. 31	$5\frac{1}{2}$	$3\frac{1}{4} \times 4\frac{1}{4}$	$33^\circ \times 42^\circ$	$1\frac{9}{16}$	39.5	Ser. VI
No. 32	$6\frac{3}{8}$	$4 \times 5$	$35^\circ \times 43^\circ$	$1\frac{3}{4}$	44.5	Ser. VII
No. 33	$7\frac{1}{2}$	$5 \times 7$	$37^\circ \times 53^\circ$	2	50.5	Ser. VII
No. 34	$8\frac{1}{2}$	$5 \times 8$	$33^\circ \times 50^\circ$	$2\frac{3}{8}$	60	Ser. VIII
No. 35	10	$6\frac{1}{2} \times 8\frac{1}{2}$	$36^\circ \times 46^\circ$	$2\frac{5}{8}$	67	Ser. VIII
No. 36	12	$8 \times 10$	$37^\circ \times 45^\circ$	$3\frac{3}{8}$	85.5	*

\*Use Eastman 4-inch Adjustable Filter Holder.

### Infrared Focusing: Extend lens from visual focus by:

- .012 inch (.3 mm.) for  $5\frac{1}{2}$ -inch (No. 31) lens
- .023 inch (.6 mm.) for  $6\frac{3}{8}$ -inch (No. 32) lens
- .027 inch (.7 mm.) for  $7\frac{1}{2}$ -inch (No. 33) lens
- .031 inch (.8 mm.) for  $8\frac{1}{2}$ - and 10-inch (No. 34 and No. 35) lenses
- .047 inch (1.2 mm.) for 12-inch (No. 36) lens

### Shutter Speeds:

No. 32 lens : 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$ ,  $\frac{1}{100}$ ,  $\frac{1}{200}$  sec., T, B.  
 No. 33 and No. 34 lens: 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$ ,  $\frac{1}{100}$  sec., T, B.  
 No. 35 and No. 36 lens: 1,  $\frac{1}{2}$ ,  $\frac{1}{5}$ ,  $\frac{1}{10}$ ,  $\frac{1}{25}$ ,  $\frac{1}{50}$  sec., T, B.

### Depth of Field: For Critical Definition No. 31 K. A. $f/4.5$ , $5\frac{1}{2}$ in.

Distance Focused On	Approximate Field Size with $3\frac{1}{4} \times 4\frac{1}{4}$ " Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		$f/4.5$	$f/8$	$f/11$	$f/22$	$f/45$
INF.	$33' \times 42'$	175 to inf.	99 to inf.	72 to inf.	36 to inf.	17 to inf.
100 feet	$59' \times 77'$	63 to 234	50 to inf.	42 to inf.	27 to inf.	15 to inf.
50 feet	$29' \times 38'$	39 to 70	33 to 101	30 to 166	21 to inf.	13 to inf.
25 feet	$14' \times 19'$	22 to 29	20 to 33	18 to 38	15 to 83	10 to inf.
15 feet	$8\frac{1}{2}' \times 11'$	14 to 16	13 to 18	12 to 19	10 to 26	8 to 105
10 feet	$5\frac{1}{2}' \times 7\frac{1}{2}'$	9 to 10	9 to 11	8 to 11	7 to 14	6 to 23
8 feet	$4\frac{1}{2}' \times 5\frac{1}{2}'$	7 to 8	7 to 8	7 to 9	6 to 10	5 to 15
6 feet	$3\frac{1}{2}' \times 4\frac{1}{2}'$	5 to 6	5 to 6	5 to 6	5 to 7	4 to 8
5 feet	$2\frac{1}{2}' \times 3\frac{1}{2}'$	4 to 5	4 to 5	4 to 5	4 to 5	3 to 6
4 feet	$2' \times 2\frac{1}{2}'$	3 to 4	3 to 4	3 to 4	3 to 4	3 to 5
$3\frac{1}{2}$ feet	$1\frac{1}{2}' \times 2\frac{1}{2}'$	3 to 3	3 to 3	3 to 3	3 to 3	2 to 4

The depth of field is not given for  $f/5.6$ ,  $f/16$ , or  $f/32$ . The depth for these openings can be estimated.

\*This equals approximately  $f/1720$ , and is for very critical definition and when extreme enlargements are to be made from the negatives. For normal work, the depth of field is greater.

**Depth of Field: For Critical Definition No. 32 K. A.  $f/4.5$ ,  $6\frac{3}{8}$  in.**

Distance Focused On	Approximate Field Size with 4 x 5" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		$f/4.5$	$f/8$	$f/11$	$f/22$	$f/45$
INF.	35° x 42°	203 to inf.	114 to inf.	83 to inf.	42 to inf.	20 to inf.
100 feet	62' x 78'	67 to 200	53 to inf.	45 to inf.	29 to inf.	17 to inf.
50 feet	31' x 39'	40 to 67	35 to 89	31 to 126	23 to inf.	15 to inf.
25 feet	15' x 18'	22 to 29	20 to 32	19 to 36	16 to 63	11 to inf.
15 feet	9' x 11'	14 to 16½	13 to 17	12 to 18	11 to 24	8 to 58
10 feet	6' x 7½'	9½ to 10½	9 to 11	9 to 11½	8 to 13	6 to 20
8 feet	4½ x 5½'	7 to 8½	7 to 8½	7 to 8½	6 to 10	5 to 13
6 feet	3½ x 4½'	5 to 6½	5 to 6½	5 to 6½	5 to 7	4 to 8½
5 feet	2½ x 3½'	4 to 5½	4 to 5½	4 to 5½	4 to 5½	4 to 6½
4 feet	2 x 2½'	3 to 4	3 to 4½	3 to 4½	3 to 4	3 to 5
3½ feet	1½ x 2½'	3 to 3	3 to 3½	3 to 3	3 to 3	3 to 4½

**Depth of Field: For Critical Definition No. 33 K. A.  $f/4.5$ ,  $7\frac{1}{2}$  in.**

Distance Focused On	Approximate Field Size with 5 x 7" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		$f/4.5$	$f/8$	$f/11$	$f/22$	$f/45$
INF.	37° x 53°	239 to inf.	134 to inf.	98 to inf.	49 to inf.	24 to inf.
200 feet	113' x 186'	109 to inf.	80 to inf.	66 to inf.	39 to inf.	21 to inf.
100 feet	66' x 93'	70 to 172	58 to inf.	50 to inf.	33 to inf.	19 to inf.
50 feet	33' x 46'	42 to 63	36 to 80	33 to 103	25 to inf.	16 to inf.
25 feet	16' x 23'	23 to 28	21 to 31	20 to 34	17 to 51	12 to inf.
15 feet	10' x 13'	14 to 16	13 to 17	13 to 18	11 to 22	9 to 40
10 feet	6½ x 8½'	9½ to 10½	9 to 11	9 to 11½	8 to 12½	7 to 17
8 feet	4 x 6½'	7 to 8½	7 to 8½	7 to 8½	6 to 9	6 to 12
6 feet	3½ x 5'	5½ to 6½	5 to 6½	5 to 6½	5 to 6½	4 to 8
5 feet	3½ x 4½'	4½ to 5½	4 to 5½	4 to 5½	4 to 5	4 to 6½
4 feet	2½ x 3½'	3 to 4	3 to 4½	3 to 4½	3 to 4	3 to 4
3½ feet	1½ x 2	3½ to 3	3 to 3½	3 to 3	3 to 3	3 to 4

**Depth of Field: For Critical Definition No. 34 K. A.  $f/4.5$ ,  $8\frac{1}{2}$  in.**

Distance Focused On	Approximate Field Size with 5 x 8" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		$f/4.5$	$f/8$	$f/11$	$f/22$	$f/45$
INF.	33° x 50°	271 to inf.	152 to inf.	111 to inf.	55 to inf.	27 to inf.
200 feet	117' x 187'	115 to inf.	86 to inf.	71 to inf.	43 to inf.	24 to inf.
100 feet	58' x 93'	73 to 158	60 to 292	53 to inf.	36 to inf.	21 to inf.
50 feet	29' x 52'	42 to 61	37 to 75	34 to 91	26 to inf.	18 to inf.
25 feet	14' x 23'	24 to 27	21 to 30	20 to 32	17 to 46	13 to inf.
15 feet	8' x 13½'	14½ to 16½	13 to 17	13 to 17½	12 to 21	9 to 34
10 feet	5½ x 8½'	9½ to 10½	9 to 10½	9 to 11	8 to 12	7 to 16
8 feet	4 x 6½'	7 to 8½	7 to 8½	7 to 8½	7 to 9	6 to 11
6 feet	3 x 5'	5 to 6½	5 to 6½	5 to 6½	5 to 6½	5 to 7
5 feet	2½ x 4'	4 to 5½	4 to 5½	4 to 5½	4 to 5	4 to 6
4 feet	2 x 3½'	3 to 4	3 to 4½	3 to 4½	3 to 4	3 to 4
3½ feet	1½ x 2	3½ to 3	3 to 3½	3 to 3	3 to 3	3 to 4

**Depth of Field: For Critical Definition No. 35 K. A.  $f/4.5$ , 10 in.**

Distance Focused On	Approximate Field Size with 6½ x 8½" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		$f/4.5$	$f/8$	$f/11$	$f/22$	$f/45$
INF.	36° x 46°	318 to inf.	179 to inf.	130 to inf.	65 to inf.	32 to inf.
400 feet	259' x 339'	175 to inf.	124 to inf.	98 to inf.	56 to inf.	29 to inf.
200 feet	129' x 169'	128 to 550	95 to inf.	79 to inf.	49 to inf.	27 to inf.
100 feet	65' x 85'	78 to 144	64 to 226	57 to inf.	39 to inf.	24 to inf.
50 feet	32' x 42'	43 to 59	39 to 69	36 to 81	28 to 114	19 to inf.
25 feet	16' x 21'	23 to 27	22 to 29	21 to 31	18 to 40	14 to 117
15 feet	9' x 12'	14 to 16	13 to 16½	13 to 17	12 to 20	10 to 28
10 feet	6' x 8'	9 to 10½	9 to 10½	9 to 11	8 to 12	7 to 14
8 feet	4 x 6'	7 to 8½	7 to 8½	7 to 8½	7 to 9	6 to 10½
6 feet	3½ x 4½'	5 to 6½	5 to 6½	5 to 6½	5 to 6½	5 to 7
5 feet	2½ x 3	4 to 5	4 to 5½	4 to 5½	4 to 5½	4 to 5
4 feet	2 x 2½'	3 to 4	3 to 4½	3 to 4½	3 to 4	3 to 4
3½ feet	1½ x 2½'	3 to 3	3 to 3½	3 to 3	3 to 3	3 to 4

The depth of field is not given for  $f/5.6$ ,  $f/16$ , or  $f/32$ . The depth for these openings can be estimated. \*This equals approximately  $f/1720$ , and is for very critical definition, and when extreme enlargements are to be made from the negatives. For normal work, the depth of field is greater.

**Depth of Field: For Critical Definition No. 36 K. A. f/4.5, 12 in.**

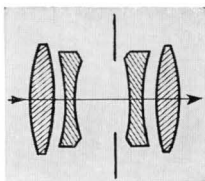
Distance Focused On	Approximate Field Size with 8 x 10" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		f/4.5	f/8	f/11	f/22	f/45
INF.	37° x 45°	382 to inf.	215 to inf.	156 to inf.	78 to inf.	38 to inf.
400 feet	266' x 332'	185 to inf.	140 to inf.	112 to inf.	65 to inf.	35 to inf.
200 feet	133' x 166'	135 to 425	110 to inf.	88 to inf.	56 to inf.	32 to inf.
100 feet	66' x 83'	81 to 135	68 to 187	61 to 278	45 to 310	28 to inf.
50 feet	33' x 41'	45 to 57	41 to 65	38 to 74	31 to 139	22 to inf.
25 feet	16' x 20'	24 to 26	22 to 28	21 to 30	19 to 37	15 to 73
15 feet	9' x 12'	14 to 15	14 to 16	13 to 17	12 to 19	11 to 25
10 feet	6' x 7'	9 to 10	9 to 10	9 to 10	8 to 12	8 to 14
8 feet	4' x 5'	7 to 8	7 to 8	7 to 8	7 to 8	6 to 10
6 feet	3' x 4'	5 to 6	5 to 6	5 to 6	5 to 6	5 to 7
5 feet	2' x 3'	4 to 5	4 to 5	4 to 5	4 to 5	4 to 5
4 feet	2' x 2'	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4
3½ feet	1½' x 2½'	3 to 3	3 to 3	3 to 3	3 to 3	3 to 3

The depth is not given for f/5.6, f/16, or f/32. For these openings depth can be estimated by comparison.

\*This equals approximately f/1720 and is for very critical definition and when extreme enlargements are to be made from the negatives. For normal work the depth of field is greater.

**Specifications:****No. 70 KODAK ANASTIGMAT f/7.7, 8 in.**

This lens, primarily intended for the Eastman 2D View and other 5 x 7 cameras, is of the symmetrical, air-spaced type which retains its corrections to a high degree when used for extreme close-ups. It gives extremely sharp definition over the whole field for all subject distances at maximum lens aperture. This lens is supplied in a Kodak Flash Supermatic Shutter.



**Lens Speed:** f/7.7, marked apertures—f/7.7, f/11, f/16, f/22, f/32, and f/45.

**Focal Length:** 8 inches, 203 mm., Back Focus 7½ inches, 190 mm.

**Infrared Focusing:** Extend lens .016 inch (.4 mm.) from visual focus.

**Negative Size:** 5 x 7 inches.

**Angle of View:** When focused for infinity, 35° x 47°.

**Shutter Speeds:** 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, 1/400 sec., T, B, built-in flash synchronization, and blade-arrester.

**Diameter of Lens Board Mounting Hole:** 1½ inches (38 mm.).

**Attachment Size:** 1½ in., 33 mm., Ser. VI Attachments.

**Depth of Field: For Critical Definition No. 70 K. A. f/7.7, 8 in.**

Distance Focused On	Approximate Field Size with 5 x 7" Neg.	DEPTH OF FIELD—IN FEET. Circle of Confusion, 2' arc.*				
		f/7.7	f/11	f/16	f/22	f/45
INF.	35° x 47°	149 to inf.	104 to inf.	72 to inf.	52 to inf.	26 to inf.
200 feet	124' x 174'	86 to inf.	68 to inf.	53 to inf.	41 to inf.	23 to inf.
100 feet	62' x 87'	60 to 304	51 to inf.	42 to inf.	34 to inf.	21 to inf.
50 feet	31' x 43'	37 to 75	34 to 96	30 to 165	26 to inf.	17 to inf.
25 feet	15' x 21'	21 to 30	20 to 33	18 to 38	17 to 48	13 to inf.
15 feet	8½' x 12½'	14 to 17	13 to 18	12 to 19	11 to 21	9 to 36
10 feet	5½' x 8½'	9 to 10	9 to 11	8 to 11	8 to 12	7 to 16
8 feet	4' x 6'	7 to 8	7 to 8	7 to 9	6 to 9	6 to 11
6 feet	3' x 4'	5 to 6	5 to 6	5 to 6	5 to 6	4 to 8
5 feet	2' x 3'	4 to 5	4 to 5	4 to 5	4 to 5	4 to 6
4 feet	2' x 2'	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4
3½ feet	1½' x 2½'	3 to 3	3 to 3	3 to 3	3 to 3	3 to 4

The depth is not given for f/32. For this opening depth can be estimated by comparison.

\*This equals approximately f/1720 and is for very critical definition and when extreme enlargements are to be made from the negatives. For normal work the depth of field is greater.

**Kodak Lenses Supplied Separately in Shutters or Barrels for Use on Commercial, Portrait, Press,  
View, and Reflex Cameras with Interchangeable Lens Boards**

LENS		Available in	Focal Length		Back Fo- cus in.	Recommended Maximum Negative Size inches	Angle of View when focused for "inf." with recommended Negative Size	Kodak Adapter Ring Size		Kodak Lens Attach. Ser.	Diameter of Lens Board Mounting Hole		Over-All Length of Lens Mount inches
			in.	mm.				in.	mm.		in.	mm.	
Kodak Ektar	<i>f/4.5, 101 mm.</i>	Flash Supermatic Shutter	4	101	3½	2¼ x 3¼	32° x 45°	1¼	31.5	VI	1⅝	35	1
Kodak Ektar	<i>f/3.7, 105 mm.</i>	Flash Supermatic Shutter	4⅝	105	3⅞	2¼ x 3¼	31° x 42°	1½	38	VI	1⅝	35	1⅜ <sub>32</sub>
Kodak Ektar	<i>f/4.7, 127 mm.</i>	Flash Supermatic Shutter	5	127	4⅞	3¼ x 4¼	36° x 46°	1½	38	VI	1½	38	1⅜ <sub>32</sub>
No. 31 Kodak Anastigmat	<i>f/4.5, 5½ in.</i>	Barrel only	5½	140	5	3¼ x 4¼	33° x 42°	1⅞	39.5	VI	1⅝	47.5	1⅞
No. 32 Kodak Anastigmat	<i>f/4.5, 6⅝ in.</i>	No. 3 Supermatic Shutter Barrel	6¼	161	5½	4 x 5	35° x 43°	1½	44.5	VII	2	50.5	1⅞
			6⅝	161	5½	4 x 5	35° x 43°	1½	44.5	VII	2⅜ <sub>32</sub>	53	1⅞ <sub>16</sub>
No. 33 Kodak Anastigmat	<i>f/4.5, 7½ in.</i>	No. 4 Ilex Univ. Shutter Barrel	7½	190	6½	5 x 7	37° x 53°	2	50.5	VII	2½	67	1⅞
			7⅝	190	6½	5 x 7	37° x 53°	2	50.5	VII	2½	60	1⅞
No. 70 Kodak Anastigmat	<i>f/7.7, 8 in.</i>	Flash Supermatic Shutter	8	203	7½	5 x 7	35° x 47°	1⅞	33	VI	1½	38	1¼
Eastman Ektar	<i>f/6.3, 8½ in.</i>	No. 3 Ilex Univ. Shutter Barrel	8½	216	7½	5 x 7	33° x 45°	1½	44.5	VII	2⅞ <sub>16</sub>	55	1¼
			8⅝	216	7½	5 x 7	33° x 45°	1½	44.5	VII	2⅞ <sub>16</sub>	55	1¼
No. 34 Kodak Anastigmat	<i>f/4.5, 8½ in.</i>	No. 4 Ilex Univ. Shutter Barrel	8½	216	7½	5 x 8	33° x 50°	2½	60	VIII	2½	67	1⅞
			8⅝	216	7½	5 x 8	33° x 50°	2½	60	VIII	2½	67	1⅞ <sub>16</sub>
Eastman Ektar	<i>f/6.3, 10 in.</i>	No. 4 Ilex Univ. Shutter Barrel	10	254	9½	6½ x 8½	36° x 46°	2½	54	VIII	2½	67	2⅞ <sub>16</sub>
			10	254	9½	6½ x 8½	36° x 46°	2½	54	VIII	2½	67	2⅞ <sub>16</sub>
No. 35 Kodak Anastigmat	<i>f/4.5, 10 in.</i>	No. 5 Ilex Univ. Shutter Barrel	10	254	9	6½ x 8½	36° x 46°	2½	67	VIII	3⅜	86	2½
			10	254	9	6½ x 8½	36° x 46°	2½	67	VIII	3⅜	73	2⅞ <sub>16</sub>
Eastman Ektar	<i>f/6.3, 12 in.</i>	No. 4 Ilex Univ. Shutter Barrel	12	304	11	8 x 10	37° x 45°	2½	63.5	VIII	2½	73	2½
			12	304	11	8 x 10	37° x 45°	2½	63.5	VIII	2½	73	2½
No. 36 Kodak Anastigmat	<i>f/4.5, 12 in.</i>	No. 5 Ilex Univ. Shutter Barrel	12	304	10⅝	8 x 10	37° x 45°	3⅜	85.5	—*	3⅜	86	2⅞ <sub>16</sub>
			12	304	10⅝	8 x 10	37° x 45°	3⅜	85.5	—*	3⅜	92	2⅞ <sub>16</sub>
Eastman Ektar	<i>f/6.3, 14 in.</i>	No. 5 Ilex Univ. Shutter Barrel	14	356	12½	8 x 10	32° x 40°	2⅞ <sub>16</sub>	75	—*	3⅜	86	2⅞ <sub>16</sub>
			14	356	12½	8 x 10	32° x 40°	2⅞ <sub>16</sub>	75	—*	3⅞ <sub>16</sub>	81	2⅞ <sub>16</sub>

Kodak Flash Supermatic (pre-setting): 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, 1/400, T, B, with Blade Arrester and built-in flash synchronization.

Kodak No. 3 Supermatic (pre-setting): 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/200, T, B, with Blade Arrester and built-in delayed-action release.

Ilex Universal (self-setting) No. 3: 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/150, T, B; No. 4: 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, T, B; No. 5: 1, 1/2, 1/5, 1/10, 1/25, 1/50, T, B—

\*Use Eastman 4-in. Adjustable Filter Holder.

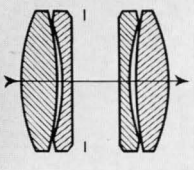
# Kodak Projection Lenses for Enlarging

Among the many lenses manufactured by the Eastman Kodak Company, there is a group designed particularly for enlarging. A good camera lens is not necessarily the best enlarger lens. Enlarger lenses must work between the flat surface of the paper and the flat negative at relatively short subject-

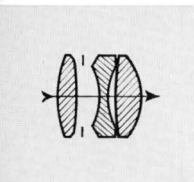
image distances. Kodak enlarging lenses have a flat field, good covering power, and precise corrections of aberrations at short working distances. The Projection Ektars are specially designed for color work and corrected for lateral chromatic aberrations to an exceptionally high degree.

LENS	Aperture Range	Focal Length		For Negatives Up To	Adapter Ring Size		Lens Attachment Series	Supplied in	Used for
		in.	mm.		in.	mm.			
Eastman Projection Anastigmat $f/4.5$ , 10 in.	$f/4.5-f/32$	10	254	8 x 10 in.	$2\frac{3}{4}$	67	VIII	—	Eastman Projection Printer 8 x 10 Line Process work with above Printer Eastman Auto-Focus Enlarger 5 x 7
Eastman Projection Anastigmat $f/8$ , 10 in.	$f/8-f/45$	10	254	8 x 10 in.	$1\frac{1}{4}$	44.5	VII	—	
*Eastman Projection Anastigmat $f/4.5$ , 7½ in.	$f/4.5-f/32$	7½	190	5 x 7 in.	2	50.5	VII	—	
Kodak Projection Anastigmat $f/4.5$ , 6¼ in.	$f/4.5-f/22$	6¼	161	4 x 5 in.	2	50.5	VII	} 2½" x 2½" lens boards	Kodak Precision Enlarger with "B" Assembly and Kodak Advance Enlarger
Kodak Projection Anastigmat $f/4.5$ , 5¼ in.	$f/4.5-f/22$	5¼	135	3¼ x 4¼ in.	1¼	44.5	VII		
Kodak Projection Anastigmat $f/6.3$ , 5 in.	$f/6.3-f/16$	5	128	2½ x 4¼ in.	1⅞	39.5	VI		
*Kodak Projection Ektar $f/4.5$ , 4 in.	$f/4.5-f/22$	4	100	2¼ x 3¼ in.	1⅞	39.5	VI	} focusing tube	As above but with small negatives and Kodak Precision Enlarger with "A" Assembly
Kodak Projection Anastigmat $f/4.5$ , 4 in.	$f/4.5-f/22$	4	105	2¼ x 3¼ in.	1⅞	39.5	VI		
*Kodak Projection Ektar $f/4.5$ , 3 in.	$f/4.5-f/22$	3	75	2¼ x 2¼ in.	1⅞	30	V		
Kodak Projection Anastigmat $f/4.5$ , 3 in.	$f/4.5-f/22$	3	75	2¼ x 2¼ in.	1⅞	30	V		
*Kodak Projection Ektar $f/4.5$ , 2 in.	$f/4.5-f/22$	2	50	1⅞ x 1⅞ in.	1⅞	23.5	V	} focusing tube	Kodak Precision Enlarger with "A" Assembly and Kodak Advance Enlarger
Kodak Projection Anastigmat $f/4.5$ , 2 in.	$f/4.5-f/22$	2	50	1⅞ x 1⅞ in.	1⅞	23.5	V		
Kodak Projection Anastigmat $f/6.3$ , 2 in.	$f/6.3$ fixed	2	50	1⅞ x 1⅞ in.	1⅞	20.5	V		
Kodak Projection Anastigmat $f/11.0$ , 98 mm.	$f/11.0$ fixed	4	98	3¼ x 4¼ in.	1	25.5	V		
*Kodak Projection Ektar $f/4.5$ , 2 in.	$f/4.5-f/22$	2	50	28 x 40 mm.	1⅞	23.5	V	} focusing tube	Kodak Portable Miniature Enlarger for 24 x 36 and 28 x 40 mm. negatives
Kodak Projection Anastigmat $f/4.5$ , 2 in.	$f/4.5-f/22$	2	50	28 x 40 mm.	1⅞	23.5	V		
Kodak Projection Anastigmat $f/6.3$ , 2 in.	$f/6.3$ fixed	2	51	28 x 40 mm.	1⅞	20.5	V		
Kodak Anastigmat $f/7.7$ , 130 mm.	$f/11.0$ fixed	5	130	4 x 5 in.	1	25.5	V	—	Kodak Auto-Focus Enlarger Mod. C
*Eastman Projection Anastigmat "K" $f/4.5$ , 105 mm.	$f/4.5-f/22$	4	105	28 x 40 mm.	1¼	31.5	VI	—	Process color work from 24 x 36 and 28 x 40 mm. originals

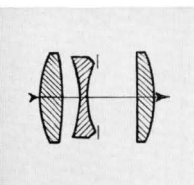
\*Specially corrected for lateral chromatic aberration.



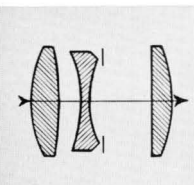
K. A. f/1.9, 25 mm.



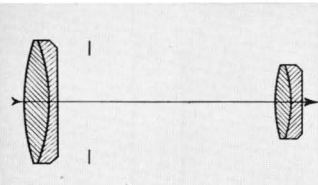
K. A. f/2.7, 15 mm.



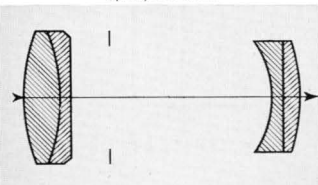
K. A. f/3.5, 20 mm.



K. A. f/3.5, 50 mm.



K. A. f/1.6, 50 mm., f/2.7, 63 mm., and f/2.7, 102 mm.



K. A. f/4.5, 76 mm., f/4.5, 114 mm., and f/4.5, 152 mm.

## LENSES FOR CINÉ-KODAK—16 MM.

### KODAK ANASTIGMAT:

**f/1.9, 25 mm.** This high speed lens of normal focal length is the ideal all-purpose lens, able to cope with extremely poor light conditions. Angle of View:  $21.5^\circ \times 16.2^\circ$ . Focusing Range: Inf. to 2 ft. Attachment Size: W Mount or  $1\frac{1}{8}$  in., 27 mm., Ser. V Attachments.

**f/2.7, 15 mm.** This wide-angle lens includes a greater picture area from a given position than any other Ciné-Kodak lens. This is especially useful for photography in close quarters. Angle of View:  $34.0^\circ \times 25.7^\circ$ . Focusing Range: Inf. to 6 inches. Attachment Size:  $1\frac{1}{8}$  in., 39.5 mm., Ser. VI Attachments.

**f/3.5, 20 mm.** A moderate speed lens for home movie cameras designed for simplicity in operation. Angle of View:  $26.5^\circ \times 20.0^\circ$ . Focusing Range: Fixed Focus. Attachment Size: Z Mount.

**f/3.5, 50 mm.** This lens gives twice the image size as compared with the normal focal length. Its speed is ample for general photography. Angle of View:  $10.9^\circ \times 8.1^\circ$ . Focusing Range: Inf. to  $2\frac{1}{4}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 27 mm., Ser. V Attachments.

**f/1.6, 50 mm.** This long-focus lens gives twice the image size of the 25-mm. lens and, because of its unusual speed, is especially useful for sport and similar pictures under extremely poor light conditions. Angle of View:  $10.8^\circ \times 8.1^\circ$ . Focusing Range: Inf. to 2 ft.\*† Attachment Size: Ser. VI Retaining Ring, Ser. VI Attachments.

**f/2.7, 63 mm.** This long-focus lens will serve best when medium telephoto effects under unfavorable light conditions are desired. Angle of View:  $8.7^\circ \times 6.5^\circ$ . Focusing Range: Inf. to  $1\frac{1}{2}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 33 mm., Ser. VI Attachments.

**f/4.5, 76 mm.** A telephoto lens giving an image size three times larger than the one obtained with a 25-mm. lens. Angle of View:  $7.2^\circ \times 5.4^\circ$ . Focusing Range: Inf. to  $3\frac{3}{4}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 27 mm., Ser. V Attachments.

**f/2.7, 102 mm.** This fast long-focus lens is especially useful when light conditions or fast shutter speeds call for a large lens aperture. Angle of View:  $5.4^\circ \times 4.1^\circ$ . Focusing Range: Inf. to  $4\frac{1}{2}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 46 mm., Ser. VII Attachments.

**f/4.5, 114 mm.** This telephoto lens will serve well where lens speed is not a prime consideration. Angle of View:  $4.8^\circ \times 3.6^\circ$ . Focusing Range: Inf. to  $4\frac{1}{4}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 33 mm., Ser. VI Attachments.

**f/4.5, 152 mm.** This telephoto lens gives a six times larger image size than that obtained with a 25-mm. lens and is especially useful when large image size at great distances is essential. Angle of View:  $3.6^\circ \times 2.7^\circ$ . Focusing Range: Inf. to 10 ft.\* Attachment Size:  $1\frac{1}{8}$  in., 39.5 mm., Ser. VI Attachments.

\*With cameras having a Reflex Focusing or an Accessory Focusing Finder, it is possible to focus this lens much closer after lifting a plunger or removing a screw.

†This lens has a depth of field indicator.

**Table of Field Sizes for 16 mm. Ciné-Kodak Lenses**

Name	Kodak Anastigmat <i>f</i> /3.5, 20 mm. ( <sup>15</sup> / <sub>16</sub> in.)		Kodak Anastigmat <i>f</i> /2.7, 15 mm. ( <sup>3</sup> / <sub>8</sub> in.)		Kodak Anastigmat <i>f</i> /1.9, 25 mm. (1 in.)		Kodak Anastigmat <i>f</i> /1.6, 50 mm. (2 in.)		Kodak Anastigmat <i>f</i> /3.5, 50 mm. (2 in.)		Kodak Anastigmat <i>f</i> /2.7, 63 mm. (2½ in.)		Kodak Telephoto Anast. <i>f</i> /4.5, 76 mm. (3 in.)		Kodak Anastigmat <i>f</i> /2.7, 102 mm. (4 in.)		Kodak Telephoto Anast. <i>f</i> /4.5, 114 mm. (4½ in.)		Kodak Telephoto Anast. <i>f</i> /4.5, 152 mm. (6 in.)	
	Fixed Focus		Focusing Mount																	
Angular Field at Inf.	26.5° x 20.0°		34.0° x 25.7°		21.5° x 16.2°		10.8° x 8.1°		10.9° x 8.1°		8.7° x 6.5°		7.2° x 5.4°		5.4° x 4.1°		4.8° x 3.6°		3.6° x 2.7°	
	Field Size																			
Distance* to subject	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.
400 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25 3	18 10
200 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12 7	9 5
100 feet	—	—	—	—	—	—	19 —	14 2	19 —	14 2	—	—	—	—	12 7	9 5	19 —	14 2	16 10	12 7
50 feet	23 6	17 7	—	—	19 —	14 2	9 5½	7 1	9 5½	7 1	7 7	5 8	6 3½	4 8	4 8½	3 6	4 2	3 1	3 1	2 3½
25 feet	11 9	8 9½	—	—	9 5½	7 1	4 8½	3 6½	4 8½	3 6½	3 9	2 10	3 1	2 3½	2 4	1 9	2 3½	1 6½	1 6	1 1
15 feet	7 ½	5 3½	9 2	6 10	5 8	4 3	2 10	2 1½	2 9½	2 1½	2 3	1 8½	1 10	1 4½	1 4½	1 1	1 2½	10½	10½	7 ½
12 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10 feet	4 8½	3 6	—	—	3 9	2 9½	1 10½	1 5	1 10½	1 4½	1 5½	1 1½	1 1	1 2½	10½	8½	—	9½	6½	—
8 feet	3 9	2 9½	4 10½	3 7½	3 —	2 3	1 6	1 1½	1 5½	1 1½	1 2½	10	—	8½	—	11	—	7½	5½	—
6 feet	2 9½	2 1½	3 8	2 8½	2 3	1 8	1 1½	10½	1 1½	9½	10½	7½	8½	6½	—	6½	—	4½	3½	—
5 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4½ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4¼ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4 feet	1 10½	1 4½	2 5½	1 9½	1 5½	1 1½	9	6½	8½	6½	6½	5½	5½	3½	—	—	—	3½	2½	—
3¾ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3½ feet	1 5	1 ¾	1 9½	1 4½	1 1½	9½	6½	5	6½	4½	5	4½	3½	—	—	—	—	—	—	—
3 feet	—	—	1 6	1 1½	—	—	5	4½	—	—	—	—	—	—	—	—	—	—	—	—
2½ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2¼ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1½ feet	—	—	1 2½	10½	—	8½	6½	4½	3½	—	—	—	—	—	—	—	—	—	—	—
1¼ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 foot	—	—	9	6½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 foot	—	—	7½	5½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Field Size—distance settings less than 1 ft. Kodak Anastigmat <i>f</i> /2.7, 15 mm. ( <sup>3</sup> / <sub>8</sub> in.)																				
	Distance* to subject		Width ft. in.		Height ft. in.															
	10 inches		— 5¾		— 4¼															
	9 inches		— 5¼		— 3¾															
	8 inches		— 4½		— 3¼															
	7 inches		— 4		— 3															
	6 inches		— 3½		— 2¾															

**Field Size**—distance settings less than 1 ft.  
Kodak Anastigmat *f*/2.7, 15 mm. ( $\frac{3}{8}$  in.)

Distance* to subject	Width ft. in.	Height ft. in.
10 inches	— 5¾	— 4¼
9 inches	— 5¼	— 3¾
8 inches	— 4½	— 3¼
7 inches	— 4	— 3
6 inches	— 3⅝	— 2⅝

\*Distances measured from front of camera for all lenses except *f*/1.6, 50 mm. lens, for which they are measured from the engraved focusing line on the lens barrel.

# DEPTH OF FIELD TABLES FOR 16 MM. CINÉ-KODAK LENSES

The distances given in the following tables are measured from the front of the camera except for the Kodak Anastigmat  $f/1.6$ , 50 mm., for which they are measured from the engraved focusing line on lens barrel.

The depth of field for  $f$ -numbers not given or for intermediate diaphragm settings can be estimated by comparison.

"inf." is the abbreviation for "infinity."

## Depth of Field: Kodak Anastigmat $f/1.9$ , 25 mm. (1 in.)

Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	$f/1.9$		$f/2.8$		$f/4$		$f/5.6$		$f/8$		$f/16$	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
INF.	44	— inf.	30	— inf.	21	— inf.	15	— inf.	10	6	5	3
50 feet	23	— inf.	18	8	15	— inf.	11	6	8	7	4	9
25 feet	16	58	13	7	11	4	9	4	7	5	4	4
15 feet	11	23	10	— 30	8	9	7	6	6	2	3	11
10 feet	8	2	7	6	6	9	6	30	5	1	3	5
8 feet	6	9	6	4	5	9	5	2	4	6	3	2
6 feet	5	3	5	— 7	4	8	4	3	3	10	2	9
4 feet	3	8	3	6	3	4	3	2	2	11	2	3
3 feet	2	10	2	3	2	3	2	6	2	4	1	1
2 feet	1	11	2	1	1	10	2	2	1	8	1	5

## Depth of Field: Kodak Anastigmat $f/2.7$ , 15 mm. (5/8 in.)

Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	$f/2.7$		$f/4$		$f/5.6$		$f/8$		$f/11$		$f/16$	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
INF.	12	— inf.	8	— inf.	5	9	4	— inf.	3	— inf.	2	— inf.
15 feet	6	8	5	3	4	2	3	2	2	5	1	9
8 feet	4	10	3	— inf.	3	4	2	8	2	2	1	7
6 feet	4	— 12	3	5	3	— inf.	2	5	2	— inf.	1	6
5 feet	3	7	3	1	2	8	38	2	3	10	1	5
4 feet	3	— 6	2	8	2	4	13	2	— inf.	1	8	4
3 feet	2	5	2	2	2	— 6	3	1	9	12	1	6
2 1/2 feet	2	1	1	1	1	1	6	7	1	4	1	1
2 feet	1	9	2	5	1	6	3	— 4	1	2	6	4
1 1/2 feet	1	4	1	3	1	2	2	1	1	2	5	1
1 1/4 feet	1	1	1	1	1	— 7	— 11	1	9	— 10	3	1
1 foot	— 11	1	— 10	1	— 10	1	2	9	1	4	— 8	1
10 in.	— 9	— 10	— 9	— 11	— 8	— 11	8	8	1	2	7	1
9 in.	— 8	— 9	— 8	— 9	— 8	— 10	7	— 11	7	1	6	1
8 in.	— 7	— 8	— 7	— 8	— 7	— 9	6	— 9	6	— 10	6	1
7 in.	— 6	— 7	— 6	— 7	— 6	— 7	6	— 8	6	— 8	5	— 10
6 in.	— 5	— 6	— 5	— 6	— 5	— 6	5	— 6	5	— 7	5	— 7

## Depth of Field: Kodak Anastigmat $f/3.5$ , 20 mm. (13/16 in.)

Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	$f/3.5$		$f/4$		$f/5.6$		$f/8$		$f/11$		$f/16$	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
Fixed Focus	7	8	7	2	5	11	4	8	3	9	2	9

## Depth of Field: Kodak Anastigmat $f/1.6$ , 50 mm. (2 in.) and $f/3.5$ , 50 mm. (2 in.)

Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	$f/1.6$		$f/2$		$f/3.5$		$f/5.6$		$f/11$		$f/22$	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
INF.	210	— inf.	168	— inf.	95	— inf.	60	— inf.	30	— inf.	15	— inf.
100 feet	68	— 190	63	— 250	48	— inf.	38	— inf.	23	— inf.	14	— inf.
50 feet	40	— 66	38	— 71	33	— 108	27	— 310	19	— inf.	11	6
25 feet	22	— 28	22	— 29	20	— 34	17	6	14	— 150	9	6
15 feet	14	— 16	13	9	16	13	12	— 23	10	— 30	7	6
10 feet	9	6	10	6	10	9	11	2	8	6	15	— 30
8 feet	7	8	8	7	8	7	8	7	7	6	11	— 5
6 feet	5	10	6	5	6	5	6	5	6	5	7	6
5 feet	4	10	5	4	5	4	5	4	5	4	6	5
4 1/2 feet	3	11	4	3	4	3	4	3	4	3	5	4
4 feet	3	11	4	3	4	3	4	3	4	3	5	4
3 1/2 feet	3	11	3	3	3	3	3	3	3	3	4	3
3 feet	2	11	3	2	3	2	3	2	3	2	3	2
2 1/2 feet	2	11	2	2	2	2	2	2	2	2	3	2
2 feet	1	11	2	1	2	1	2	1	2	1	2	1



**Depth of Field: Kodak Anastigmat f/2.7, 63 mm. (2½ in.)**

Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	f/2.7		f/4		f/5.6		f/8		f/11		f/22	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
INF.	193	— inf.	130	— inf.	93	— inf.	65	— inf.	47	— inf.	24	— inf.
50 feet	40	— 67	36	— 81	32	— 108	28	— 216	24	— inf.	16	— inf.
25 feet	22	— 29	21	— 31	20	— 34	18	— 40	16	— 52	12	— inf.
15 feet	14	— 16.2	13.5	— 16.11	12.11	— 17.11	12.2	— 19.5	11.5	— 22	9.3	— 41
10 feet	9.6	— 10.6	9.4	— 10.10	9	— 11.3	8.8	— 11.10	8.4	— 12.8	7	— 17.8
8 feet	7.8	— 8.4	7.6	— 8.6	7.5	— 8.8	7.1	— 9.1	6.11	— 9.7	6	— 12
6 feet	5.9	— 6.3	5.9	— 6.4	5.7	— 6.5	5.6	— 6.7	5.4	— 6.10	4.10	— 8
5 feet	4.11	— 5.1	4.10	— 5.2	4.9	— 5.3	4.8	— 5.5	4.7	— 5.6	4.2	— 6.4
4 feet	3.11	— 4.1	3.11	— 4.1	3.10	— 4.2	3.10	— 4.3	3.8	— 4.4	3.6	— 4.10
3 feet	2.11	— 3	2.11	— 3	2.11	— 3.1	2.10	— 3.1	2.10	— 3.2	2.8	— 3.5
2 feet	1.11	— 2	1.11	— 2	1.11	— 2	1.11	— 2	1.11	— 2	1.10	— 2.9
1½ feet	1.5	— 1.6	1.5	— 1.6	1.5	— 1.6	1.5	— 1.6	1.5	— 1.6	1.5	— 1.7

**Kodak Anastigmat f/2.7, 102 mm. (4 in.)**

INF.	494	— inf.	332	— inf.	238	— inf.	167	— inf.	121	— inf.	61	— inf.
200 feet	142	— 336	125	— 500	109	— inf.	91	— inf.	75	— inf.	47	— inf.
100 feet	83	— 125	77	— 143	70	— 172	62	— 250	55	— 576	38	— inf.
50 feet	46	— 56	44	— 59	41	— 63	38	— 71	35	— 85	27	— 286
25 feet	23.10	— 26.3	23.4	— 27	22.8	— 28	21.10	— 29.6	20.10	— 31.7	17.8	— 42
15 feet	14.6	— 15.6	14.4	— 15.8	14.1	— 16	13.10	— 16.6	13.5	— 17.1	12	— 20
12 feet	11.8	— 12.4	11.7	— 12.5	11.5	— 12.7	11.2	— 12.11	10.11	— 13.4	10	— 15
10 feet	9.10	— 10.2	9.9	— 10.3	9.7	— 10.5	9.5	— 10.7	9.3	— 10.11	8.7	— 12
8 feet	7.11	— 8.1	7.10	— 8.2	7.9	— 8.3	7.7	— 8.4	7.6	— 8.6	7.1	— 9.2
6 feet	5.11	— 6.1	5.11	— 6.1	5.10	— 6.1	5.9	— 6.2	5.8	— 6.3	5.6	— 6.7
5 feet	4.11	— 5	4.11	— 5	4.10	— 5.1	4.10	— 5.1	4.9	— 5.2	4.8	— 5.5
4½ feet	4.5	— 4.6	4.5	— 4.6	4.5	— 4.7	4.4	— 4.7	4.4	— 4.8	4.2	— 4.10

**Depth of Field: Kodak Anastigmat f/4.5, 76 mm. (3 in.)**

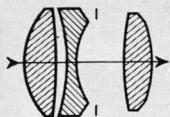
Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	f/4.5		f/5.6		f/8		f/11		f/16		f/22	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
INF.	167	— inf.	134	— inf.	94	— inf.	68	— inf.	47	— inf.	34	— inf.
100 feet	62	— 250	58	— 390	49	— inf.	41	— inf.	32	— inf.	26	— inf.
50 feet	39	— 70	37	— 80	33	— 105	29	— 185	24	— inf.	21	— inf.
25 feet	22	— 29	21	— 31	20	— 34	19	— 39	16.6	— 52	14.8	— 85
15 feet	13.10	— 16.4	13.6	— 16.10	13	— 17.9	12.5	— 19	11.5	— 21.8	10.7	— 26
12 feet	11.3	— 12.10	11	— 13.2	10.8	— 13.8	10.4	— 14.5	9.8	— 15.10	9	— 18
10 feet	9.6	— 10.7	9.4	— 10.9	9.1	— 11	8.10	— 11.6	8.4	— 12.6	7.11	— 13.8
8 feet	7.8	— 8.4	7.7	— 8.5	7.5	— 8.8	7.3	— 9	7	— 9.6	6.8	— 10.2
6 feet	5.10	— 6.2	5.9	— 6.3	5.8	— 6.4	5.7	— 6.6	5.5	— 6.9	5.3	— 7.1
5 feet	4.10	— 5.2	4.10	— 5.2	4.9	— 5.3	4.8	— 5.4	4.7	— 5.6	4.6	— 5.9
4½ feet	4.5	— 4.7	4.5	— 4.7	4.4	— 4.8	4.3	— 4.9	4.2	— 4.11	4.1	— 5.1
4 feet	3.11	— 4.1	3.11	— 4.1	3.10	— 4.2	3.10	— 4.2	3.9	— 4.3	3.8	— 4.5
3½ feet	3.8	— 3.10	3.8	— 3.10	3.8	— 3.10	3.7	— 3.11	3.6	— 4	3.5	— 4.1

**Kodak Anastigmat f/4.5, 114 mm. (4½ in.)**

INF.	375	— inf.	300	— inf.	210	— inf.	155	— inf.	105	— inf.	77	— inf.
200 feet	130	— 430	120	— 590	105	— inf.	87	— inf.	69	— inf.	56	— inf.
100 feet	79	— 135	75	— 148	68	— 190	61	— 285	52	— inf.	44	— inf.
50 feet	45	— 57	44	— 60	41	— 65	38	— 73	34	— 96	31	— 140
25 feet	23.6	— 26.8	23	— 27	22	— 28	22	— 29	20	— 32	19	— 36
15 feet	14.6	— 15.7	14.4	— 15.9	14.1	— 16.1	13.9	— 16.6	13.3	— 17.3	12.8	— 18.4
12 feet	11.8	— 12.5	11.7	— 12.6	11.5	— 12.8	11.2	— 13	10.10	— 13.5	10.6	— 14
10 feet	9.9	— 10.3	9.8	— 10.4	9.7	— 10.5	9.5	— 10.7	9.2	— 11	9	— 11.4
8 feet	7.10	— 8.2	7.10	— 8.3	7.9	— 8.4	7.8	— 8.5	7.6	— 8.7	7.4	— 8.10
6 feet	5.11	— 6.1	5.11	— 6.2	5.11	— 6.2	5.10	— 6.3	5.9	— 6.4	5.7	— 6.5
5 feet	4.11	— 5.1	4.11	— 5.1	4.11	— 5.1	4.10	— 5.2	4.10	— 5.2	4.9	— 5.3
4½ feet	4.2	— 4.4	4.2	— 4.4	4.2	— 4.4	4.2	— 4.4	4.2	— 4.4	4.1	— 4.5

**Depth of Field: Kodak Anastigmat f/4.5, 152 mm. (6 in.)**

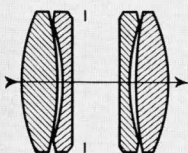
Distance Focused On	On 16-mm. Ciné-Kodak. Circle of Confusion, 1/1000 inch											
	f/4.5		f/5.6		f/8		f/11		f/16		f/22	
	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.	ft. in.	to ft. in.
INF.	670	— inf.	540	— inf.	375	— inf.	275	— inf.	190	— inf.	137	— inf.
400 feet	250	— 1000	230	— 1580	195	— inf.	163	— inf.	128	— inf.	102	— inf.
200 feet	154	— 285	146	— 320	130	— 425	116	— 750	97	— inf.	82	— inf.
100 feet	87	— 117	84	— 123	79	— 135	73	— 157	65	— 212	58	— 370
50 feet	47	— 54	46	— 55	44	— 57	42	— 61	40	— 67	37	— 78
25 feet	24.3	— 25.11	24	— 26.2	23.6	— 26.8	23	— 27.4	22.3	— 28.8	21.4	— 30
15 feet	14.8	— 15.4	14.7	— 15.5	14.5	— 15.7	14.3	— 15.9	14	— 16.2	13.7	— 16.8
12 feet	11.9	— 12.3	11.9	— 12.3	11.8	— 12.4	11.6	— 12.6	11.4	— 12.8	11	— 13
10 feet	9.10	— 10.2	9.10	— 10.2	9.9	— 10.3	9.8	— 10.4	9.6	— 10.6	9.5	— 10.7



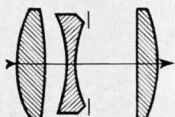
K. A.  $f/3.5$ , 13 mm., and  $f/2.7$ , 13 mm.



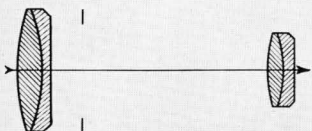
K. A.  $f/2.7$ , 9 mm.



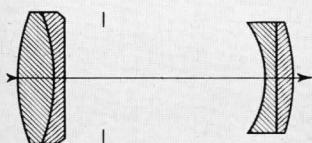
K. A.  $f/1.9$ , 13 mm., and  $f/1.9$ , 25 mm.



K. A.  $f/3.5$ , 50 mm.



K. A.  $f/2.5$ , 38 mm.,  $f/1.6$ , 50 mm., and  $f/2.7$ , 63 mm.



K. A.  $f/4.5$ , 76 mm.

## LENSES FOR CINÉ-KODAK EIGHT

### KODAK ANASTIGMAT:

**$f/3.5$ , 13 mm.** This lens of normal focal length combines sufficient speed for all outdoor and some indoor work with simplicity in use. Angle of View:  $19.7^\circ \times 14.9^\circ$ . Focusing Range: Fixed Focus. Attachment Size: Z Mount.

**$f/2.7$ , 13 mm.** This lens, also of normal focal length and fixed focus design, is about 70% faster than  $f/3.5$ , permitting picture taking under less favorable light conditions. Angle of View:  $18.7^\circ \times 14.1^\circ$ . Focusing Range: Fixed Focus. Attachment Size: Z Mount.

**$f/2.7$ , 9 mm.** A wide-angle lens designed to include a large field—a feature especially useful for photography in close quarters. Angle of View:  $26.1^\circ \times 19.8^\circ$ . Focusing Range: Fixed Focus. Attachment Size:  $\frac{5}{16}$  in., 23.5 mm., Ser. V Attachments.

**$f/1.9$ , 13 mm.** This ultra fast standard focal length lens—twice as fast as  $f/2.7$  and 3.5 times as fast as  $f/3.5$ —is the ideal lens for all-round outdoor and indoor filming, even under adverse light conditions. Angle of View:  $19.4^\circ \times 14.6^\circ$ . Focusing Range: Inf. to 2 ft. Attachment Size: Magazine Model,  $\frac{5}{16}$  in., 23.5 mm. Ser. V Attachments. 8-60 Model,  $\frac{5}{16}$  in., 20.5 mm. Ser. V Attachments.

**$f/1.9$ , 25 mm.** This lens gives twice the image size of the 13-mm. lens and is useful for pictures when a near-by camera position is not accessible. Angle of View:  $9.9^\circ \times 7.4^\circ$ . Focusing Range: Inf. to 2 ft. Attachment Size: W Mount or  $1\frac{1}{8}$  in., 27 mm., Ser. V Attachments.

**$f/2.5$ , 38 mm.** A long-focus lens—with three times the film image size given by a normal focal length lens. Angle of View:  $6.6^\circ \times 5.0^\circ$ . Focusing Range: Inf. to 2 ft.\*† Attachment Size: Ser. V Retaining Ring, Ser. V Attachments.

**$f/1.6$ , 50 mm.** This long-focus lens combines considerable image magnification (about 4 times) with ultra-fast speed, making it the ideal lens for telephoto effects under adverse light conditions. Angle of View:  $4.9^\circ \times 3.7^\circ$ . Focusing Range: Inf. to 2 ft.\* Attachment Size: Ser. VI Retaining Ring, Ser. VI Attachments.

**$f/3.5$ , 50 mm.** While this lens gives the same image size as the one above, its speed is less, yet ample for all general outdoor and some indoor long distance filming. Angle of View:  $5^\circ \times 3.7^\circ$ . Focusing Range: Inf. to  $2\frac{1}{4}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 27 mm., Ser. V Attachments.

**$f/2.7$ , 63 mm.** This lens gives a five times telephoto effect as compared to a view obtained with a 13-mm. focal length lens. Angle of View:  $4^\circ \times 3^\circ$ . Focusing Range: Inf. to  $1\frac{1}{2}$  ft.\* Attachment Size:  $1\frac{5}{16}$  in., 33 mm., Ser. VI Attachments.

**$f/4.5$ , 76 mm.** This telephoto lens gives an image six times larger than the one made with the 13-mm. lens. Angle of View:  $3.3^\circ \times 2.5^\circ$ . Focusing Range: Inf. to  $3\frac{3}{4}$  ft.\* Attachment Size:  $1\frac{1}{8}$  in., 27 mm., Ser. V Attachments.

\*With a Kodak Focusing Finder, it is possible to focus this lens much closer after lifting a plunger or removing a screw.

†This lens has a depth of field indicator.

**Table of Field Sizes for Ciné-Kodak Eight Lenses**

Name	Kodak Anastigmat <i>f</i> /2.7, 9 mm. ( $\frac{3}{8}$ in.)		Kodak Anastigmat <i>f</i> /2.7, 13 mm. ( $\frac{1}{2}$ in.)		Kodak Anastigmat <i>f</i> /3.5, 13 mm. ( $\frac{1}{2}$ in.)		Kodak Anastigmat <i>f</i> /1.9, 13 mm. ( $\frac{1}{2}$ in.)		Kodak Anastigmat <i>f</i> /1.9, 25 mm. (1 in.)		Kodak Anastigmat <i>f</i> /2.5, 38 mm. (1 $\frac{1}{2}$ in.)		Kodak Anastigmat <i>f</i> /1.6, 50 mm. (2 in.)		Kodak Anastigmat <i>f</i> /3.5, 50 mm. (2 in.)		Kodak Anastigmat <i>f</i> /2.7, 63 mm. (2 $\frac{1}{2}$ in.)		Kodak Telephoto Anast. <i>f</i> /4.5, 76 mm. (3 in.)	
	Fixed Focus						Focusing Mount													
Angular Field at Inf.	26.1° x 19.8°		18.7° x 14.1°		19.7° x 14.9°		19.4° x 14.6°		9.9° x 7.4°		6.6° x 5.0°		4.9° x 3.7°		5.0° x 3.7°		4.0° x 3.0°		3.3° x 2.5°	
	Field Size																			
Distance* to subject	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.	Width ft. in.	Height ft. in.
100 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8 8	6 6	8 8	6 6	—	—
50 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4 3 $\frac{3}{4}$	3 3	4 3 $\frac{3}{4}$	3 3	3 5 $\frac{1}{2}$	2 7
25 feet	11 7	8 8 $\frac{1}{2}$	8 2 $\frac{3}{4}$	6 2	8 8 $\frac{1}{2}$	6 6 $\frac{1}{2}$	8 6 $\frac{1}{4}$	6 5	4 3 $\frac{3}{4}$	3 2 $\frac{3}{4}$	2 10 $\frac{1}{2}$	2 2	2 1 $\frac{3}{4}$	1 7 $\frac{1}{2}$	2 1 $\frac{1}{4}$	1 7 $\frac{1}{2}$	1 8 $\frac{1}{2}$	1 3 $\frac{1}{2}$	1 5	1 5
15 feet	6 11 $\frac{1}{2}$	5 2 $\frac{3}{4}$	4 11 $\frac{1}{4}$	3 8 $\frac{1}{2}$	5 3	3 11 $\frac{1}{4}$	5 1 $\frac{1}{4}$	3 10 $\frac{1}{2}$	2 6 $\frac{3}{4}$	1 11	1 8 $\frac{1}{2}$	1 3 $\frac{1}{2}$	1 3 $\frac{1}{2}$	—	11 $\frac{1}{8}$	1 3 $\frac{1}{2}$	—	11 $\frac{1}{2}$	1 1 $\frac{1}{4}$	9 $\frac{1}{4}$
12 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9 $\frac{1}{4}$	—	9 $\frac{1}{4}$	—	7 $\frac{1}{4}$
10 feet	4 7 $\frac{1}{4}$	3 6	3 3 $\frac{1}{2}$	2 5 $\frac{1}{4}$	3 6	2 7 $\frac{1}{2}$	3 5 $\frac{1}{4}$	2 7	1 8 $\frac{1}{2}$	1 3 $\frac{1}{4}$	1 1 $\frac{1}{4}$	10 $\frac{3}{8}$	10 $\frac{3}{8}$	7 $\frac{1}{8}$	10 $\frac{1}{8}$	7 $\frac{1}{8}$	8 $\frac{1}{8}$	6 $\frac{1}{8}$	6 $\frac{1}{8}$	4 $\frac{1}{8}$
8 feet	3 8 $\frac{1}{2}$	2 9 $\frac{1}{2}$	2 7 $\frac{3}{4}$	1 11 $\frac{3}{4}$	2 9 $\frac{1}{2}$	2 1 $\frac{1}{4}$	2 1 $\frac{1}{4}$	2 9 $\frac{1}{2}$	2 1 $\frac{1}{4}$	1 4 $\frac{1}{4}$	1 1 $\frac{1}{4}$	—	8 $\frac{1}{4}$	8 $\frac{1}{4}$	6 $\frac{1}{4}$	8 $\frac{1}{4}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$	4 $\frac{1}{4}$	5 $\frac{1}{4}$
6 feet	2 9 $\frac{1}{2}$	2 1 $\frac{1}{4}$	1 11 $\frac{1}{4}$	1 5 $\frac{1}{4}$	2 1 $\frac{1}{4}$	1 6 $\frac{1}{4}$	2 1 $\frac{1}{4}$	1 6 $\frac{1}{4}$	2 1 $\frac{1}{4}$	1 6 $\frac{1}{4}$	—	9 $\frac{1}{4}$	—	8 $\frac{1}{4}$	6 $\frac{1}{4}$	4 $\frac{1}{4}$	6 $\frac{1}{4}$	4 $\frac{1}{4}$	3 $\frac{1}{4}$	2 $\frac{1}{4}$
5 feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5 $\frac{1}{8}$	5 $\frac{1}{8}$	3 $\frac{1}{8}$	5	3 $\frac{1}{8}$	2 $\frac{1}{8}$
4 $\frac{1}{2}$ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4 feet	1 10 $\frac{1}{2}$	1 5	1 3 $\frac{7}{8}$	—	11 $\frac{1}{8}$	1 4 $\frac{1}{2}$	1 1 $\frac{3}{8}$	1 4 $\frac{1}{2}$	1 1 $\frac{1}{2}$	8 $\frac{1}{4}$	6 $\frac{1}{4}$	5 $\frac{1}{2}$	4 $\frac{1}{8}$	4 $\frac{1}{8}$	3 $\frac{1}{8}$	4 $\frac{1}{8}$	3 $\frac{1}{8}$	3 $\frac{1}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{8}$
3 $\frac{3}{4}$ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3 $\frac{1}{2}$ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3 feet	1 5	1 3 $\frac{3}{4}$	—	11 $\frac{1}{8}$	8 $\frac{1}{4}$	1 1 $\frac{3}{8}$	—	9 $\frac{1}{2}$	1 1 $\frac{1}{2}$	9 $\frac{1}{4}$	6	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3	—	3 $\frac{1}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{8}$	1 $\frac{3}{8}$	—
2 $\frac{1}{2}$ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 $\frac{1}{4}$ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 feet	—	11 $\frac{1}{8}$	—	8 $\frac{1}{2}$	8	—	6	8 $\frac{1}{2}$	6 $\frac{1}{2}$	8 $\frac{1}{4}$	6 $\frac{1}{4}$	4	—	3	—	2 $\frac{1}{8}$	2	—	—	—
1 $\frac{1}{2}$ feet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

\*Distances measured from front of camera for all lenses except f/2.5, 38 mm. and f/1.6, 50 mm. lenses for which they are measured from the engraved focusing line on the lens barrel.

## DEPTH OF FIELD TABLES FOR CINÉ-KODAK EIGHT LENSES

The distances given in the following tables are measured from the front of the camera except for Kodak Anastigmat  $f/2.5$ , 38 mm., and  $f/1.6$ , 50 mm., for which they are measured from the engraved focusing line on the lens barrel.

The depth of field for  $f$ -numbers not given or for intermediate diaphragm settings can be estimated by comparison.

"inf." is the abbreviation for "infinity."

### Depth of Field: Kodak Anastigmat $f/3.5$ , and $f/2.7$ , 13 mm., and $f/2.7$ , 9 mm.

Fixed Focus	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	$f/2.7$		$f/3.5$		$f/5.6$		$f/8$		$f/11$		$f/16$	
	ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.	
$f/3.5$ , 13 mm. ( $\frac{1}{2}$ inch)	—	—	5 10	inf.	4 6	inf.	3 7	inf.	2 10	inf.	2 1	inf.
$f/2.7$ , 13 mm. ( $\frac{1}{2}$ inch)	8 6	inf.	6 10	inf.*	5 6	inf.	4 3	inf.	3 4	inf.	2 5	inf.
$f/2.7$ , 9 mm. ( $\frac{3}{4}$ inch)	4 3	inf.	3 5	inf.*	2 9	inf.	2 2	inf.	1 8	inf.	1 3	inf.

\*These distances are for  $f/4$ .

### Depth of Field: Kodak Anastigmat $f/1.9$ , 13 mm. ( $\frac{1}{2}$ in.)

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	$f/1.9$		$f/2.8$		$f/4$		$f/5.6$		$f/11$		$f/22$	
	ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.	
INF.	22 6	inf.	15 3	inf.	10 7	inf.	7 7	inf.	3 10	inf.	1 11	inf.
50 feet	15 6	inf.	11 8	inf.	8 9	inf.	6 7	inf.	3 7	inf.	1 10	inf.
25 feet	11 10	inf.	9 6	inf.	7 6	inf.	5 10	inf.	3 4	inf.	1 9	inf.
15 feet	9 —	45 —	7 7	75 —	6 3	inf.	5 1	inf.	3 1	inf.	1 8	inf.
10 feet	6 11	18 —	6 1	29 —	5 2	156 —	4 4	inf.	2 10	inf.	1 7	inf.
8 feet	5 11	12 5	5 3	16 10	4 7	32 —	3 11	inf.	2 7	inf.	1 6	inf.
6 feet	4 9	8 2	4 4	9 11	3 10	13 8	3 4	28 —	2 4	inf.	1 5	inf.
4 feet	3 5	4 10	3 2	5 5	2 11	6 5	2 7	8 5	1 11	inf.	1 4	inf.
3 feet	2 8	3 6	2 6	3 9	2 4	4 2	2 2	4 11	1 8	13 2	1 2	inf.
2 feet	1 10	2 2	1 9	2 4	1 8	2 6	1 7	2 9	1 4	4 2	1 —	inf.

### Depth of Field: Kodak Anastigmat $f/1.9$ , 25 mm. (1 in.)

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	$f/1.9$		$f/2.8$		$f/4$		$f/5.6$		$f/8$		$f/16$	
	ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.	
INF.	88 —	inf.	60 —	inf.	42 —	inf.	30 —	inf.	21 —	inf.	10 5	inf.
50 feet	33 —	115 —	27 —	310 —	23 —	inf.	18 8	inf.	14 9	inf.	8 8	inf.
25 feet	19 6	35 —	17 8	43 —	15 8	62 —	13 7	154 —	11 5	inf.	7 5	inf.
15 feet	12 10	18 —	12 —	20 —	11 1	23 —	10 —	30 —	8 9	53 —	6 2	inf.
10 feet	9 —	11 3	8 7	12 —	8 1	13 1	7 6	15 —	6 9	19 2	5 1	210 —
8 feet	7 4	8 10	7 1	9 3	6 9	9 11	6 4	11 —	5 10	13 —	4 7	33 —
6 feet	5 8	6 5	5 6	6 8	5 3	7 —	5 —	7 6	4 8	8 5	3 10	14 —
4 feet	3 10	4 2	3 9	4 3	3 8	4 5	3 6	4 7	3 4	4 11	2 11	6 5
3 feet	2 11	3 1	2 10	3 1	2 9	3 2	2 8	3 4	2 7	3 6	2 4	4 2
2 feet	1 11	2 —	1 11	2 —	1 11	2 1	1 10	2 1	1 10	2 2	1 8	2 5

### Depth of Field: Kodak Anastigmat $f/2.5$ , 38 mm. ( $1\frac{1}{2}$ in.)

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	$f/2.5$		$f/4$		$f/5.6$		$f/8$		$f/11$		$f/22$	
	ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.		ft. in. to ft. in.	
INF.	150 —	inf.	94 —	inf.	67 —	inf.	47 —	inf.	34 —	inf.	17 —	inf.
50 feet	38 —	75 —	33 —	107 —	29 —	197 —	24 —	inf.	20 —	inf.	12 8	inf.
25 feet	21 —	30 —	20 —	34 —	18 2	40 —	16 3	54 —	14 5	94 —	10 1	inf.
15 feet	13 7	16 9	12 11	17 10	12 3	19 4	11 4	22 —	10 5	26 9	8 —	122 —
10 feet	9 4	10 9	9 —	11 2	8 8	11 9	8 3	12 9	7 9	14 2	6 3	24 —
8 feet	7 7	8 5	7 4	8 9	7 2	9 1	6 10	9 7	6 6	10 5	5 5	15 —
6 feet	5 9	6 3	5 8	6 5	5 6	6 7	5 4	6 11	5 1	7 3	4 5	9 3
5 feet	4 10	5 2	4 9	5 3	4 8	5 5	4 6	5 7	4 4	5 10	3 10	7 1
4 feet	3 10	4 1	3 10	4 2	3 9	4 3	3 8	4 4	3 7	4 6	3 2	5 3
3	3	3	3	3	3	3	3	3	3	3	2	4
3 feet	2 11	3 3	2 11	3 1	2 10	3 1	2 9	3 2	2 9	3 3	2 6	3 7
2 feet	2 5	2 6	2 5	2 7	2 5	2 7	2 4	2 7	2 4	2 8	2 2	2 11
2 feet	1 11	2 —	1 11	2 —	1 11	2 —	1 11	2 1	1 10	2 1	1 9	2 3

# **Depth of Field: Kodak Anastigmat f/1.6, 50 mm. (2 in.)**

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	f/1.6		f/2		f/2.8		f/5.6		f/11		f/22	
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	420 — inf.	335 — inf.	240 — inf.	120 — inf.	120 — inf.	60 — inf.	60 — inf.	30 — inf.	30 — inf.	15 — inf.	15 — inf.	7 1/2 — inf.
100 feet	81 — 130	77 — 140	70 — 170	35 — 350	35 — 350	17 — 600	17 — 600	8 — 300	8 — 300	4 — 150	4 — 150	2 — 75
50 feet	45 — 57	43 6 — 59	41 6 — 63	20 8 — 86	20 8 — 86	10 9 — 172	10 9 — 172	5 6 — 85	5 6 — 85	2 7 — 42	2 7 — 42	1 3/4 — 21
25 feet	23 7 — 26 7	23 3 — 27	22 7 — 28	13 4 — 17 2	13 4 — 17 2	6 7 — 21	6 7 — 21	3 9 — 10 1/2	3 9 — 10 1/2	1 8 — 5 1/4	1 8 — 5 1/4	7/8 — 10 1/2
15 feet	14 6 — 15 6	14 5 — 15 8	14 2 — 16 1	9 3 — 10 1 1/2	9 3 — 10 1 1/2	4 7 — 5 1/2	4 7 — 5 1/2	2 10 — 2 3/4	2 10 — 2 3/4	1 12 — 1 1/2	1 12 — 1 1/2	5/8 — 6 1/4
10 feet	9 9 — 10 3	9 8 — 10 4	9 7 — 10 5	6 7 — 7 1/4	6 7 — 7 1/4	3 10 — 3 1/2	3 10 — 3 1/2	1 12 — 1 1/2	1 12 — 1 1/2	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 1 1/2
8 feet	7 10 — 8 2	7 10 — 8 2	7 9 — 8 3	4 8 — 5 1/4	4 8 — 5 1/4	2 11 — 2 3/4	2 11 — 2 3/4	1 12 — 1 1/2	1 12 — 1 1/2	5/8 — 3/4	5/8 — 3/4	10/16 — 1 1/4
6 feet	5 11 — 6 1	5 11 — 6 1	5 10 — 6 2	3 11 — 3 1/2	3 11 — 3 1/2	2 5 — 2 3/4	2 5 — 2 3/4	1 6 — 1 1/4	1 6 — 1 1/4	3/4 — 7/8	3/4 — 7/8	7/8 — 1 1/4
5 feet	4 11 — 5 1	4 11 — 5 1	4 10 — 5 2	2 11 — 2 3/4	2 11 — 2 3/4	1 6 — 1 1/4	1 6 — 1 1/4	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
4 feet	3 11 — 4 1/2	3 11 — 4 1/2	3 10 — 4 1/4	1 11 — 1 1/2	1 11 — 1 1/2	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
3 feet	2 11 — 3 1/2	2 11 — 3 1/2	2 10 — 3 1/4	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
2 feet	1 11 — 2 1/2	1 11 — 2 1/2	1 10 — 2 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
1 1/2 feet	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8

# **Depth of Field: Kodak Anastigmat f/3.5, 50 mm. (2 in.)**

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	f/3.5		f/5.6		f/8		f/11		f/16		f/22	
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	190 — inf.	120 — inf.	85 — inf.	60 — inf.	42 — inf.	30 — inf.	30 — inf.	15 — inf.	15 — inf.	7 1/2 — inf.	7 1/2 — inf.	3 3/4 — inf.
100 feet	66 — 210	54 — 635	45 — inf.	38 — inf.	28 — 285	23 — inf.	23 — inf.	12 — 100	12 — 100	6 — 50	6 — 50	3 — 25
50 feet	40 — 68	35 — 86	31 — 125	28 — 285	17 9 — 42	15 8 — 36	13 7 — 30	8 10 — 19	8 10 — 19	4 12 — 10	4 12 — 10	2 14 — 7
25 feet	22 — 29	21 — 31	19 3 — 35	17 9 — 42	12 11 — 19 11	11 11 — 16 11	10 11 — 14 11	6 13 — 9 10	6 13 — 9 10	3 16 — 5 1/2	3 16 — 5 1/2	2 19 — 3 1/4
15 feet	13 11 — 16 3	13 4 — 17 2	12 9 — 18 3	12 11 — 19 11	8 11 — 13 1	7 11 — 10 1	6 10 — 8 8	4 13 — 5 10	4 13 — 5 10	2 16 — 3 1/2	2 16 — 3 1/2	1 19 — 2 1/4
12 feet	11 4 — 12 9	10 11 — 13 4	10 6 — 14 —	10 11 — 14 11	7 11 — 10 1	6 10 — 8 8	5 9 — 7 7	3 13 — 4 10	3 13 — 4 10	2 16 — 3 1/2	2 16 — 3 1/2	1 19 — 2 1/4
10 feet	9 6 — 10 7	9 3 — 10 11	9 — 11 4	8 7 — 11 11	6 10 — 8 8	5 9 — 7 7	4 13 — 5 10	3 16 — 5 1/2	3 16 — 5 1/2	2 19 — 3 1/4	2 19 — 3 1/4	1 22 — 2 1/4
8 feet	7 8 — 8 4	7 6 — 8 7	7 4 — 8 10	7 1 — 9 2	5 9 — 7 7	4 13 — 5 10	3 16 — 5 1/2	2 19 — 3 1/4	2 19 — 3 1/4	1 22 — 2 1/4	1 22 — 2 1/4	1 25 — 2 1/4
6 feet	5 10 — 6 2	5 9 — 6 4	5 7 — 6 5	5 6 — 6 8	4 10 — 4 13	3 13 — 4 10	2 16 — 3 1/2	1 19 — 2 1/4	1 19 — 2 1/4	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8
5 feet	4 11 — 5 1	4 10 — 5 2	4 9 — 5 4	4 8 — 5 5	3 13 — 4 10	3 13 — 4 10	2 19 — 3 1/4	1 22 — 2 1/4	1 22 — 2 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
4 feet	3 11 — 4 1/2	3 10 — 4 1/4	3 10 — 4 1/4	3 9 — 4 13	2 16 — 3 1/2	2 16 — 3 1/2	1 19 — 2 1/4	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
3 feet	2 11 — 3 1/2	2 11 — 3 1/2	2 10 — 3 1/4	2 10 — 3 1/4	1 19 — 2 1/4	1 19 — 2 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
2 feet	1 11 — 2 1/2	1 10 — 2 1/4	1 10 — 2 1/4	1 9 — 2 3/4	7/8 — 1 1/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
1 1/2 feet	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8

# **Depth of Field: Kodak Anastigmat f/2.7, 63 mm. (2 1/2 in.)**

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	f/2.7		f/4		f/5.6		f/8		f/11		f/22	
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	385 — inf.	260 — inf.	185 — inf.	130 — inf.	95 — inf.	70 — inf.	50 — inf.	35 — inf.	25 — inf.	18 — inf.	13 — inf.	9 — inf.
50 feet	44 — 57	42 — 62	40 — 63	36 — 81	33 — 105	24 — 66	21 — 53	19 — 34	17 — 44	16 — 40	14 — 35	12 — 30
25 feet	23 6 — 26 9	23 — 27 9	22 — 28 9	21 — 31	19 9 — 34	16 11 — 21 11	13 10 — 16 11	13 — 17 9	11 11 — 14 11	10 11 — 13 11	8 12 — 11 12	7 14 — 9 14
15 feet	14 5 — 15 7	14 2 — 15 11	13 11 — 16 4	13 6 — 16 11	13 — 17 9	10 10 — 13 11	9 9 — 12 10	8 8 — 11 9	7 7 — 10 8	6 6 — 9 7	5 5 — 8 6	4 4 — 7 5
10 feet	9 9 — 10 3	9 8 — 10 5	9 6 — 10 6	9 4 — 10 10	9 1 — 11 2	7 8 — 9 9	6 7 — 8 8	5 6 — 7 7	4 5 — 6 6	3 4 — 5 5	2 3 — 4 4	1 2 — 3 3
8 feet	7 10 — 8 2	7 9 — 8 3	7 8 — 8 4	7 7 — 8 6	6 6 — 8 8	5 5 — 7 7	4 4 — 6 6	3 3 — 5 5	2 2 — 4 4	1 1 — 3 3	7/8 — 1 1/4	3/4 — 7/8
6 feet	5 11 — 6 1	5 10 — 6 1 1/2	5 10 — 6 1 1/2	5 9 — 6 3	5 8 — 6 5	4 7 — 5 4	3 6 — 4 3	2 5 — 3 2	1 4 — 2 1	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8
5 feet	4 11 — 5 1	4 11 — 5 1	4 10 — 5 2	4 10 — 5 2 1/2	4 9 — 5 3 1/2	3 8 — 4 4	2 7 — 3 3	1 6 — 2 2	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
4 feet	3 11 — 4 1/2	3 11 — 4 1/2	3 11 — 4 1	3 10 — 4 1	3 10 — 4 1	2 9 — 3 4	1 8 — 2 3	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
3 feet	2 11 — 3 1/2	2 11 — 3 1/2	2 11 — 3 1/2	2 11 — 3 1/2	2 11 — 3 1/2	1 10 — 2 3	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
2 feet	1 11 — 2 1/2	1 10 — 2 1/4	1 10 — 2 1/4	1 9 — 2 3/4	1 9 — 2 3/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
1 1/2 feet	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8

# **Depth of Field: Kodak Anastigmat f/4.5, 76 mm. (3 in.)**

Distance Focused On	On Ciné-Kodak Eight. Circle of Confusion, 1/2000 inch											
	f/4.5		f/5.6		f/8		f/11		f/16		f/22	
	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.	ft. in. to ft. in.
INF.	335 — inf.	270 — inf.	190 — inf.	135 — inf.	95 — inf.	70 — inf.	50 — inf.	35 — inf.	25 — inf.	18 — inf.	13 — inf.	9 — inf.
100 feet	77 — 140	73 — 160	65 — 210	58 — 370	49 — 310	37 — 240	33 — 210	20 — 140	17 — 110	14 — 80	12 — 60	10 — 50
50 feet	44 — 59	42 — 61	40 — 68	37 — 78	33 — 105	29 — 53	26 — 44	20 — 34	18 — 28	16 — 19	14 — 14	12 — 12
25 feet	23 3 — 27	23 — 27 6	22 — 29	21 3 — 30	20 — 34	18 — 28	16 — 21	13 — 17	11 — 14	10 — 13	8 12 — 11 12	7 14 — 9 14
15 feet	14 5 — 15 8	14 3 — 15 10	14 — 16 3	13 7 — 16 9	13 — 17 9	11 11 — 14 11	10 11 — 13 11	9 11 — 12 11	8 10 — 11 10	7 9 — 10 9	6 8 — 8 8	5 7 — 7 7
12 feet	11 7 — 12 5	11 6 — 12 6	11 4 — 12 9	11 1 — 13 1	10 9 — 13 10	9 8 — 12 9	8 7 — 11 8	7 6 — 10 7	6 5 — 9 6	5 4 — 8 5	4 3 — 7 4	3 2 — 6 3
10 feet	9 9 — 10 3	9 8 — 10 4	9 6 — 10 6	9 4 — 10 8	8 3 — 10 9	7 2 — 9 4	6 1 — 8 3	5 1 — 7 2	4 1 — 6 1	3 1 — 5 1	2 1 — 4 1	1 1 — 3 1
8 feet	7 10 — 8 2	7 9 — 8 3	7 8 — 8 4	7 7 — 8 5	6 6 — 8 6	5 5 — 7 5	4 4 — 6 4	3 3 — 5 3	2 2 — 4 2	1 1 — 3 1	7/8 — 1 1/4	3/4 — 7/8
6 feet	5 11 — 6 1	5 10 — 6 1 1/2	5 10 — 6 1 1/2	5 9 — 6 3	5 8 — 6 5	4 7 — 5 4	3 6 — 4 3	2 5 — 3 2	1 4 — 2 1	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8
5 feet	4 11 — 5 1	4 10 — 5 2	4 10 — 5 2	4 10 — 5 2 1/2	4 9 — 5 3 1/2	3 8 — 4 4	2 7 — 3 3	1 6 — 2 2	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
4 feet	3 11 — 4 1/2	3 11 — 4 1/2	3 11 — 4 1	3 10 — 4 1	3 10 — 4 1	2 9 — 3 4	1 8 — 2 3	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
3 feet	2 11 — 3 1/2	2 11 — 3 1/2	2 11 — 3 1/2	2 11 — 3 1/2	2 11 — 3 1/2	1 10 — 2 3	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
2 feet	1 11 — 2 1/2	1 10 — 2 1/4	1 10 — 2 1/4	1 9 — 2 3/4	1 9 — 2 3/4	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8
1 1/2 feet	7/8 — 1 1/4	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8	3/4 — 7/8

### Kodak Lenses for Kodascopes and Kodaslide Projectors

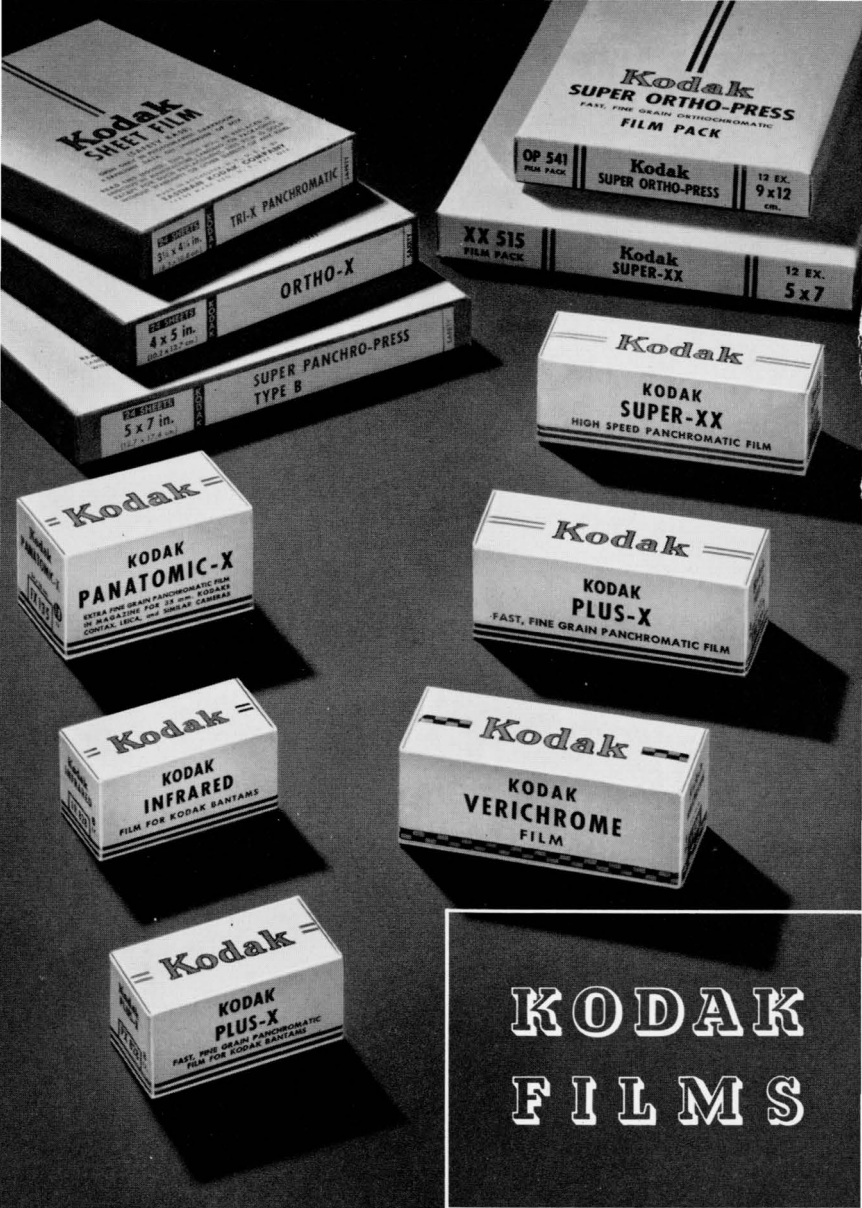
Lenses ordinarily used on Kodascopes and Kodaslide Projectors have twice the focal length of the usual taking lenses, and consequently a narrower angle of view. For 16-mm. Kodascopes, a 2-inch (50 mm.), for 8-mm. Kodascopes, a 1-inch (25 mm.), and for Kodaslide Projectors a 4- or 5-inch lens is recommended for normal use. With these lenses, a picture of proper perspective is presented to a spectator seated about half way

between projector and screen. For use in small rooms where the throw is limited, 1- and 1½-inch lenses are available for 16-mm. Kodascopes. Projection lenses with longer focal length are useful for larger rooms where long throws with large screen sizes are needed. All lenses listed below are made with great care and precision, are highly corrected, and assure clean-cut, undistorted pictures with the projectors for which they are designed.

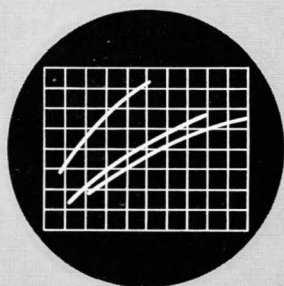
LENS	Aper- ture	Nominal Focal Length		Projection throw for different screen picture sizes						Designed for
		in.	mm.	16½" x 22"	22" x 30"	30" x 40"	39" x 52"	54" x 72"	63" x 84"	
<b>For 16-mm. Kodascopes</b>										Kodascope Model G, E, EE, Sixteen-10, Sixteen-20, and Sound Kodascope Model F Series
Kodak Projection Lens	<i>f</i> /2.5	1	25	5 ft.	6½ ft.	9 ft.	11½ ft.	16 ft.	19 ft.	
Kodak Projection Lens	<i>f</i> /2.5	1½	38	7½ ft.	10 ft.	13½ ft.	17 ft.	24 ft.	28 ft.	
Kodak Projection Lens	<i>f</i> /2.5	2	50	10 ft.	13½ ft.	18 ft.	23 ft.	32 ft.	37 ft.	
Kodak Projection Lens	<i>f</i> /1.6	2	50	10 ft.	13½ ft.	18 ft.	23 ft.	32 ft.	37 ft.	
Kodak Projection Lens	<i>f</i> /2.0	3	76	—	—	26½ ft.	34½ ft.	48 ft.	56 ft.	
Kodak Projection Lens	<i>f</i> /2.5	4	102	—	—	36 ft.	46 ft.	64 ft.	74 ft.	Sound Kodascope Special
Kodak Projection Lens	<i>f</i> /1.6	2	50	10 ft.	13½ ft.	18 ft.	23 ft.	32 ft.	37 ft.	
Kodak Projection Lens	<i>f</i> /1.4	3	76	—	—	26½ ft.	34½ ft.	48 ft.	56 ft.	
Kodak Projection Lens	<i>f</i> /1.6	4	102	—	—	36 ft.	46 ft.	64 ft.	74 ft.	
<b>For 8-mm. Kodascopes</b>										Kodascope Eight-33 Kodascope Eight-70 and 70A
Kodak Projection Lens	<i>f</i> /2.0	1	25	11 ft.	14½ ft.	19½ ft.	25 ft.	—	—	
Kodak Projection Lens	<i>f</i> /1.6	1	25	11 ft.	14½ ft.	19½ ft.	25 ft.	—	—	
Projection throw for different screen picture sizes. If vertical as well as horizontal Kodaslides are projected, a square screen is needed.										
<b>For Kodaslide Projectors</b>				15" x 22"	21" x 30"	28" x 40"	36" x 52"	50" x 72"	58" x 84"	Kodaslide Projector Model 1
Kodak Projection Lens	<i>f</i> /3.5	4	102	a: 6 ft. b: 5 ft.	8 ft. 7 ft.	10½ ft. 9 ft.	13½ ft. 12 ft.	—	—	
Kodak Projection Lens	<i>f</i> /3.5	5	127	a: 7½ ft. b: 6½ ft.	10 ft. 8½ ft.	13 ft. 11 ft.	16½ ft. 14½ ft.	23 ft. 20 ft.	26½ ft. 24 ft.	Kodaslide Projector Model 2 and 2A
Kodak Projection Lens	<i>f</i> /4.5	7½	190	a: 11 ft. b: 9½ ft.	15 ft. 13 ft.	20 ft. 17 ft.	25½ ft. 22 ft.	35 ft. 31 ft.	41 ft. 36 ft.	

Note: Screen-picture sizes are based on the following projected film areas:

16 mm.: .380 x .284 in.; 8 mm.: .172 x .129 in.; Kodaslide Projector a: 2½ x 1½ in. for 35-mm., b: 1½ x 1½ in. for Bantam.



KODAK  
FILMS





# KODAK FILMS

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## ROLLS AND PACKS

Verichrome

Plus-X

Super-XX

Super Ortho-  
Press Packs

Plus-X

Panatomic-X

Super-XX

Infrared

Direct Positive  
Panchromatic

Positive  
H. C. Positive

Micro-File

## 35-MM. & BANTAM

S. Panchro-Press,  
Sports Type

Tri-X

S. Panchro-Press,  
Type B

Super-XX

Portrait  
Panchromatic

Panatomic-X

Ortho-X

Super  
Ortho-Press

Super Speed  
Ortho Portrait

Infrared

Commercial

Contrast Process

## SHEET FILMS

Plate Data

# KODAK FILMS

THIS information has been prepared for the convenience of the photographic craftsman who desires more than a superficial knowledge of negative materials. Specific recommendations are included which will aid the worker in obtaining consistently finer results with Kodak Film.

Serious workers are today applying their originality and technical abilities to numerous fields of photography. For this reason, a knowledge of the many materials available as well as their suitability for each purpose is invaluable if the results are to meet today's high standards of photographic quality.

The high quality of Kodak-made photographic materials is the result of extensive research coupled with the technical experience of the manufacturing departments of the Eastman Kodak Company. The Kodak Research Laboratories is the foremost organization of its kind in the world, while the experience of the manufacturing divisions in making films and plates for over 50 years is unsurpassed. The meticulous care and laboratory control exercised in manufacture assure the user of maximum dependability in all Kodak sensitized products.

Negative materials differ widely from one another because they are designed for various specific purposes. Their differences may be broadly classed under two heads: photographic and physical. The term "photographic" is used here to refer to such properties as contrast, color sensitivity, and speed, while "physical" refers to the type of base, antihalation feature, and so on. An understanding of these factors is of considerable aid in selecting the negative material most suitable for any purpose.

Data Sheets are given for a number of the more popular films including the infrared types. These contain descriptions of the photographic and physical characteristics, exposure and development recommendations, and complete working instructions.

There follows a description of the various factors, both photographic and physical, which determine the suitability of any negative material for a given purpose, with specific reference to Kodak materials.

## ***Photographic Properties***

### **SENSITOMETRIC DETERMINATIONS**

MANY emulsion properties, such as contrast, exposure latitude, speed, development rate, and others are best analyzed by means of numerical measurements. The science of such analysis is known as sensitometry.

#### **The H & D or Characteristic Curve**

UNDER accurately controlled and standardized conditions, a photographic material is subjected, by means of an instrument called a sensitometer, to a series of exposures, each greater by a constant factor ( $\sqrt{2}$  or  $\sqrt[3]{2}$ ) than the preceding step. The material is developed under carefully controlled conditions, after which the density\* of each step is read on a densitometer and plotted against the logarithm of the exposure which produced it (see Figure 1). Such curves, representing the average product when exposed and processed under average practical conditions, are given in the Film Data Sheets.

Associated with a characteristic curve are:

**Toe.** For exposures less than that at A, no density results on the film.

At A, and for greater exposures, density results, and exposure differences reproduce as density differences. From A to B, density difference or "gradation" increases. This region is known as the toe of the curve and is widely used in making negatives.

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$$\text{*Density} = \text{Log} \frac{1}{\text{Transmission}} \quad \text{where} \quad \text{Transmission} = \frac{\text{Transmitted Illumination}}{\text{Incident Illumination}}$$

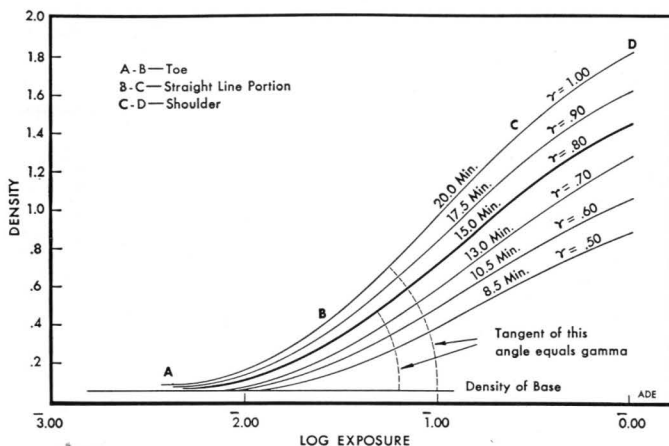


Figure 1—Typical Characteristic Curve.

**Straight-Line Portion** of the curve from B to C defines the range wherein density increases proportionally with the logarithm of exposure. This region is also usable in negative making.

**Shoulder** or region of overexposure. Above C, the gradient of the curve decreases, and eventually the curve becomes horizontal and no longer records exposure differences by corresponding density differences. Scenes recorded on the shoulder show a falling off in highlight contrast, characteristic of extreme overexposure.

**Fog Density** is the density of the unexposed but developed and fixed-out negative material. Fog increases but slightly within the recommended development time. The density of the base should not be confused with fog, since base density is constant and does not affect contrast. Base plus fog is the minimum negative density or starting point of the characteristic curve for any material. Kodak photographic materials are so made that fog is negligible if they are properly handled.

**Gamma.** The slope of the straight-line portion of the characteristic curve, or tangent of the angle it forms with the horizontal, is known as *gamma* ( $\gamma$ ). It is a measure of negative *development* contrast or degree of development. Gamma does not rigidly define toe slope, but gives an indication of its value, since in general toe slope increases with higher gamma.

Up to a certain point, gamma increases as development proceeds. This is shown graphically in Figure 1. Gamma may be plotted against development time, and the resulting time-gamma curve may subsequently be used to determine correct developing time for any desired negative gamma (see Figure 2).

Gamma also increases with (a) agitation during development, (b) higher developing temperatures, (c) increased developer strength or freshness. The effect of these and many other factors can be most readily analysed by sensitometric means.

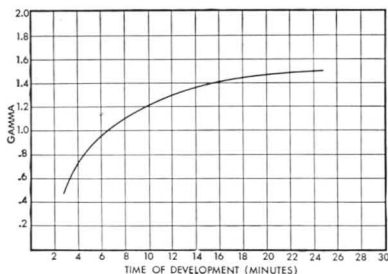


Figure 2—Typical Time-Gamma Curve.

**Latitude.** The range of tone or brightness values which can be reproduced by the film is indicated in characteristic curves as the exposure interval between a point fairly low on the toe and another point located on the shoulder. This interval is called the exposure scale of the material. Since the brightness range in most scenes is considerably less than this exposure scale, there is considerable camera exposure latitude or freedom in the choice of shutter speed and lens aperture settings. Actually, with most modern negative materials of normal contrast, the upper limit of useful exposure is set by other factors such as increased graininess, loss of definition, and difficulty of printing very dense negatives, long before the upper end of the exposure scale is reached.

## KODAK SPEEDS

THE concept of *Kodak Speed* was first introduced to the photographic public in 1939 in various technical journals and Kodak publications.

Jones, L. A. The Evaluation of Negative Film Speeds in Terms of Print Quality; J. Franklin Institute, Vol. 227, p 297 and 497, (1939).

Clark, W. The Problem of Film Speeds; Photo Technique, Vol. 1, p 12, June 1939.



San Francisco Bay Bridge—photographed on Kodak Film

Extensive research had shown that the method by which Kodak Speeds are derived gives values which agree remarkably well with the practical speeds found in normal picture-taking experience.

This method employs a sensitometric speed criterion, known as the fractional gradient criterion, which can be applied to the D-log E characteristic curve of the negative film. It selects the exposure  $E$ , at the point on the toe of the curve where the gradient (slope) is 0.3 of the average gradient over a log exposure interval of 1.5. The method is illustrated in Figure 3. Speed is computed by taking the reciprocal of the exposure value  $E$ , in meter-candle-seconds, and rounding the result to the nearest step on a scale in which the steps differ by a factor of the cube root of 2, as 100, 125, 160, 200, etc.

The above method of speed evaluation differs significantly from most others which have been used, in that the exposure on which the speed number is based is determined by a gradient rather than by a fixed density. This is exceedingly important because adequate density dif-



The speed is a unique characteristic of the photographic material which refers to the *minimum camera exposure* which will yield a final print having excellent quality. Obviously, it would be unwise to give this minimum exposure unless the conditions were such that it would be difficult or impossible to give more exposure. Also, camera exposures require consideration of other factors in addition to the speed. Therefore another type of value, derived from the speed but taking the other factors into account, is needed for use with exposure meters and other exposure computing devices.

## EXPOSURE INDEXES

The Exposure Index intended for practical use in determination of exposure is obtained by dividing the Film Speed by a number which includes a calibration factor for the exposure meter or other device and a safety factor to take care of possible variations in equipment and in the use of the meter and the handling of the photographic material. The safety factor chosen depends on the latitude of the material. A safety factor of 2.5 is used for continuous-tone black-and-white negative materials, a factor of 2.0 for black-and-white reversal films and color negative films, and a factor of 1.6 for color reversal films.

When the exposure is made by light of other than daylight quality, it may be necessary to use a different Exposure Index calculated from the Film Speed by a different ratio which contains a factor for the photographic efficiency of the illumination with the particular material. Normally, Film Exposure Indexes are given for both daylight and high efficiency tungsten illumination.

The Film Exposure Indexes for black-and-white continuous-tone negative materials are suitable for use with both the Weston and General Electric Exposure Meters. The values are slightly different from the exposure meter settings previously published, but extensive practical tests have shown that the exposure latitude of these films is more than sufficient to absorb the differences. Since color films, reversal films, and the high-contrast materials used for line copying have less camera exposure latitude, it is considered desirable to give separate settings for use with present Weston and General Electric meters because of slight difference in their calibration.

When it is desired to reduce the exposure to a minimum, as is sometimes necessary in making pictures in poor light, the Exposure Indexes for black-and-white, continuous-tone negative materials can be doubled with little danger of serious underexposure. This is not recommended as a general practice, and the values given should be used where practical.



It should also be pointed out that development conditions have considerable bearing on the proper Index value since both the type of developer and the degree of development affect the emulsion speed and hence the exposure required. The values given in Kodak publications apply for recommended development.

Any exposure index should be regarded as a logical basis for trial and should be raised or lowered if the results consistently indicate that a change is desirable. The recommended exposure indexes are based on average conditions, and the individual photographer may find it necessary to change them by a certain factor to obtain the desired results with his particular equipment and methods of working. This conversion factor will apply for all Exposure Indexes which have the same safety factor.

SPEEDS AND FILM EXPOSURE INDEXES FOR KODAK FILMS			
FILM	KODAK SPEED	FILM EXPOSURE INDEX	
		Daylight	Tungsten
<i>Roll Films and Packs</i>			
Verichrome	0200 *	50 *	25
Plus-X Panchromatic	0200 *	50 *	32
Super-XX Panchromatic	0400 *	100 *	80
Super Ortho-Press	0400 *	100 *	50
<i>35-mm. and Bantam</i>			
Super-XX Panchromatic	0400 *	100 *	64
Plus-X Panchromatic	0200 *	50 *	32
Panatomic-X	0100 *	25 *	16
<i>Sheet Films</i>			
Super Panchro-Press, Sports Type	01000	250	200
Tri-X Panchromatic	0800	200	160
Super Panchro-Press, Type B	0500	125	100
Ortho-X	0500	125	64
Super-XX Panchromatic	0400	100	64
Super Ortho-Press	0400	100	50
Portrait Panchromatic	0200	50	32
Super Speed Ortho Portrait	0200	50	25
Panatomic-X	0125	32	20
Commercial Ortho	0125	32	10
Commercial	0100	25	6
*These values of Kodak Speed and Film Exposure Index are the same respectively as the ASA Speed and ASA Film Exposure Index as specified by the American Standards Association. (No American Standard exists at the present time for determining the values which are not marked with an asterisk.)			

## METER SETTINGS FOR COPYING

THE most reliable method of using the exposure meter for copying is to take the brightness reading of a white card substituted for the subject to be copied. If the original subject is on colored stock, then a sample of this same stock should be used instead of the white card.

The white-card meter settings for normal-contrast materials for

continuous-tone copying are based on the Kodak Speeds, but the conversion ratios are different from those used to obtain the usual Exposure Index in order to compensate for the difference between highlight brightness readings and the ordinary readings of average brightness.

The white-card meter settings given for high-contrast materials for line copies are chosen to produce a background density of about 1.5, assuming ideal conditions. With these high-contrast materials this will insure having clear lines if the original is of adequate contrast.

**Settings for Meters with Scheiner and DIN Scales:** Experience has shown that different makes of meters using the same type of film rating scale may require different settings for the same film. Therefore, it is impractical to give conversion tables for use of the Film Exposure Indexes with meters marked in the Scheiner and DIN systems. The proper conversion for a particular meter is best determined by making trial exposures. An experimental meter setting can be selected, based on the relative speed of the film to be used and readings taken with the meter on a number of average scenes. Five exposures should be made on a typical scene, one as indicated by the meter with the experimental setting, the others at  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 2, and 4 times this value. Inspection of the resulting negatives and prints will indicate the proper exposure, and the corresponding meter setting can be selected accordingly. Proper settings for films with other Film Exposure Index values can easily be calculated if it is remembered that an increase of  $3^\circ$  on either the Scheiner or the DIN scales corresponds to a doubling of the Film Exposure Index. For instance, if a meter setting of  $26^\circ$  Scheiner is found to give proper exposure for a film having an Exposure Index of 50, a setting of  $29^\circ$  ( $3^\circ$  higher) should be correct for a film with an Exposure Index of 100.

## NEGATIVE CONTRAST

THE actual printing contrast of a negative depends on a number of factors which are:

1. **Subject Contrast.** The brightness scale of a scene determines to a large extent the printing contrast of the negative. The brightness scale depends on:

- a. *Reflecting Power* of various parts of the scene.
- b. *Differences in Illumination* over the scene.

For example, on a dull day, an open landscape has a low brightness scale, since differences in reflecting power alone provide contrast. On the other hand, a sunlit path in the woods usually has a high brightness scale since there are not only differences in reflecting

power but also wide differences in illumination on various parts of the scene.

**2. Exposure.** A negative which tends toward underexposure is lower in contrast as well as lower in density than a fully exposed negative. A negative which is greatly overexposed is also lower than normal in contrast but of high density.

**3. Emulsion Contrast.** The inherent contrast of the emulsion is an important factor in governing the contrast of the negative. Kodak negative materials range from low-contrast materials (Tri-X Panchromatic) through materials of higher contrast (Super Panchro-Press, Super Ortho-Press) to materials of extreme contrast (Contrast Process) which are intended to yield black-and-white negatives completely lacking in intermediate tones.

#### **4. Development Contrast**

a. *Developer Composition.* Strong developers such as Kodak D-19 can produce negatives of higher contrast than more slowly working developers such as Kodak D-76.

b. *Temperature of Developer.* Negative contrast for a given development time increases with increase in temperature, up to a point where fogging begins to reduce contrast.

c. *Time of Development.* Negative contrast increases over a wide range with increase in development time. Variation of this factor is the most satisfactory method of controlling negative contrast for a given subject, negative material, and developer. The growth of development contrast (as measured by gamma) for a number of Kodak Films in various developers is given in the form of curves in the Data Sheets.

d. *Agitation during Development* increases the rate of development, thus causing increased contrast for a given development time.

e. *Exhaustion of Developer.* Fresh developer works faster, and is capable of producing negatives of higher contrast than old overworked solutions.

f. *Fogging*, due either to extraneous light or to faulty processing, tends to reduce contrast, particularly in the shadows, by veiling over the entire negative image.

**5. Color of the Negative Image.** A brownish image, given by many fine-grain developers, such as Kodak DK-20, strongly absorbs the blue-violet light to which printing papers are most sensitive. As a result, the printing contrast is slightly higher than is indicated by curves drawn from visual measurements.

All these factors must be considered in producing negatives of

the best printing quality. The average negative material can record a much wider range of brightnesses than a printing paper can successfully reproduce. One of the principles of making excellent negatives thus lies in keeping the density range of the negatives within a printable limit.

## COLOR SENSITIVITY

THE color sensitivity of an emulsion defines the degree of its photographic response to light of various wave lengths or colors. While the average normal eye is sensitive to all these colors, the same is not necessarily true of photographic films. In fact, plain silver bromide, the fundamental sensitive element in all negative emulsions, is sensitive only to blue and ultraviolet. Incorporated in modern orthochromatic, panchromatic, and infrared emulsions, however, are sensitizing dyes, the purpose of which is to render the film sensitive to certain other colors of light. The type of sensitizing is one of a film's most important photographic characteristics because it so profoundly affects both the handling of the material and the results obtained. It is the color sensitivity of a negative material which determines the following:

- 1. The Monochromatic Rendition of Colored Subjects.** Any material which is not sensitized to green or red light will render these colors too dark, while a panchromatic material having somewhat the same sensitivity to all colors as the human eye will record colors in approximately the same relative brightnesses as they appear to the eye. By the use of the proper correction filter, a very close approximation to visual brightness rendering can be obtained.
- 2. The Relation of Speed in Tungsten Light to That in Daylight.** Every negative material has a higher speed in daylight than in tungsten light because tungsten light contains a lower percentage of the blue-violet light to which all films are *most* sensitive.  
This speed difference is less, however, in the case of films having high sensitivity to the green, yellow, orange, and red regions of the spectrum than it is with films having their principal sensitivity in the violet, blue, and green regions. The reason for this is that the former type of emulsion (panchromatic) is able to utilize the red, orange, and yellow which form a large proportion of tungsten light.
- 3. Filters Usable and Their Factors.** The filters which can be used depend on the color sensitivity of the film. Obviously, a red filter can be used only with a material sensitive to red light. Furthermore, the filter factor, or exposure increase required, also depends on the

color sensitivity of the material. For example, a negative material with a large portion of its sensitivity in the blue-violet requires a much greater relative exposure through a yellow filter which eliminates most of the blue light, than a panchromatic material which, being sensitive to all colors, is able to utilize the red and green transmitted by the filter.

- 4. Safelight Color or Transmission.** It is the function of a safelight to transmit a maximum of visible light to which the film is least sensitive. For example, a negative material, such as Kodak Verichrome Film, which is sensitive only to blue-violet, blue, and green, may be handled without danger of fogging by a safelight transmitting only deep red. In the case of materials which are sensitive to all colors, the safelight must transmit in the region to which the eye has its maximum sensitivity in order that a minimum amount of light may be used. Hence, panchromatic materials may be handled only under a dark green safelight—and that for but brief periods.

### **Wedge Spectrograms**

THE color sensitivity of a negative material is usually expressed by means of wedge spectrograms, examples of which appear in Figure 4. The numbers beneath the horizontal axis represent the color of light or the wave lengths in millimicrons ( $m\mu$  or millionths of a millimeter). These spectrograms are prepared by exposing a section of film to a light spectrum through a neutral density wedge. This wedge is opaque at the top, wedging off in density or opacity until it is transparent at the bottom. As the transmitted light diminishes toward the top, the height of the film image at any point is an indication of the film's response to that particular wave length. Due to the absorption of much of the ultraviolet by the lens system of the spectrograph, the indicated ultraviolet sensitivity of all films, as shown by the wedge spectrograms, is lower than the true value. The spectrograms show relative color sensitivity only, and give no indication of film speed.

### **SENSITIZING CLASSES AND TYPES**

KODAK negative materials are divided into sensitizing classes and types, both for purposes of description and also for convenience in the assignment of filter factors. The negative materials of any one group are sufficiently alike in color sensitivity so that the same filter factors apply. Aside from certain special sensitizings, such as the infrared and those for scientific purposes, there are three general classes as indicated on the following page.

**Non-Color-Sensitized or "Ordinary"** materials possess only the ultra-violet and blue-violet sensitivity inherent in any silver halide emulsion. **Orthochromatic** materials possess sensitivity to green, in addition to the ultraviolet and blue-violet.

**Panchromatic** materials are sensitive to red light as well as the above. They thus respond to all visible colors and ultraviolet.

Panchromatic materials are further classified into Types B and C with respect to their relative sensitivities to blue, green, and red light. Type B materials, having relatively high green sensitivity, most nearly approximate the color sensitivity of the eye. In clear-bulb tungsten light, with the X1 (light green) filter, or in daylight with the K2 (yellow) filter, Type B materials give excellent monochromatic rendering. Type C panchromatic materials have relatively high red sensitivity, and correspondingly high speed in artificial light.

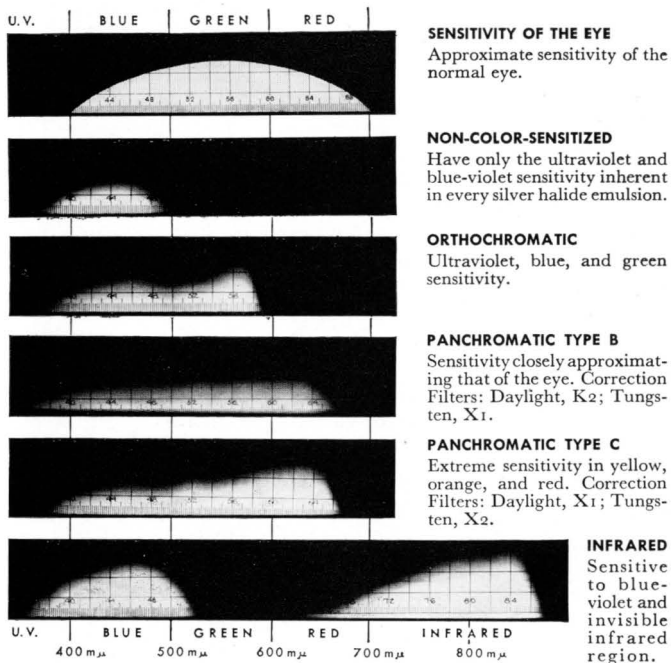


Figure 4—Spectrograms showing color sensitivity of Kodak film sensitizing types to tungsten light.

## GRAININESS

GRAININESS refers to that mottled appearance which is characteristic of every negative under sufficiently high magnification. It is caused by apparent clumping of the silver grains, rather than by the individual grains themselves which are visible only under high magnification.

### Factors Influencing Graininess

- a. Some graininess is inherent in every emulsion. For similar types of emulsions, graininess tends to increase with emulsion speed.
- b. At equal gammas, most normal developers (Kodak DK-50, Dektol, D-72, etc.) produce approximately equal graininess with a given film. Special fine-grain developers (Kodak Microdol, DK-20) produce lower graininess with some speed loss.
- c. Graininess increases with the density of the negative; therefore, it is important to avoid overexposure or overdevelopment.
- d. Graininess increases with gamma, and thus with any factor which increases the degree of development, unless the print contrast is held constant by printing on paper of lower contrast.
- e. With a given negative, increasing paper contrast increases the apparent print graininess. However, the combination of low negative gamma and high paper contrast may produce slightly lower graininess than high negative gamma and low paper contrast.
- f. Graininess is more apparent in the lighter middle tones of an image, particularly in large areas of uniform density.
- g. Graininess may be more apparent in prints from out-of-focus or soft-focus negatives than from those which are sharp.
- h. Lack of critically sharp enlarger focus tends to soften the graininess and reduce definition in the enlargement.
- i. Rough-surfaced paper usually tends to conceal graininess.



PANATOMIC-X

PLUS-X

SUPER-XX

Comparative graininess prints for three miniature films, enlarged 20 diameters. Contact print in lower left corner of the Panatomic-X figure shows actual size of negative image.

## SHARPNESS AND RESOLVING POWER

SHARPNESS is a measure of the ability of a negative material to reproduce geometrically sharp edges. All emulsions reproduce such edges as graded transitions. Sharpness is one factor which determines the best definition which can be obtained in a negative.

Resolving power refers to the ability of an emulsion to record fine detail distinguishably. It is customary to express resolving power in terms of the number of lines per millimeter that can be distinguished as separated in a photographic image. In measuring resolving power a parallel-line test chart is photographed greatly reduced in size. The lines of the test chart are separated by spaces of the same width as the lines. The image is examined under a microscope, and the number of lines per millimeter just resolved is determined. Lines closer together (more lines per millimeter) than indicated by this number will appear on the film, not as individual lines, but as an indistinct, gray mass.

The resolving power of a film depends on the contrast of the test chart, the degree of development of the film, and especially on exposure. The resolving power values given below are determined for recommended processing and for a subject contrast of 30:1 which is about the range in ordinary photography.

Resolution falls off at high and low exposure values, reaching a maximum at some intermediate exposure at which the resolving power figure is selected. The loss of resolution with over and underexposure is an important reason for exposing miniature negatives correctly.

Naturally, the lens must be capable of giving sharply separated images of the lines if the full resolving power of the emulsion is to be utilized. Most quality camera lenses do, in fact, have higher resolving power than normal negative materials.

RESOLVING POWER OF KODAK FILMS	
FILM <i>Standard Development</i>	RESOLVING POWER <i>Lines per Millimeter</i>
Panatomic-X 35 mm. and Bantam (D-76)	60
Panatomic-X 35 mm. and Bantam (DK-20)	70
Plus-X 35 mm. and Bantam	55
Super-XX 35 mm. and Bantam	50
Plus-X Rolls and Packs	50
Super-XX Rolls and Packs	45
Verichrome Rolls and Packs	45
Super Ortho-Press Packs	45
Positive Safety (35 mm.)	55
High Contrast Positive Safety (35 mm.)	100
Direct Positive Pan	70
Micro-File (35 mm.)	160



## ***Physical Properties of Kodak Negative Materials***

### **BASE**

THE film base is the support for the light-sensitive emulsion.

Kodak film base is made in various thicknesses for different negative materials: roll film, 35-mm. film, film pack, and sheet film.

1. Safety base is of cellulose acetate, is slow burning, and presents somewhat less hazard in storage than common newsprint paper in the same form and quantity.
2. Nitrate base, made of cellulose nitrate, presents a hazard if exposed to heat or open flame.
3. Specially selected glass is used for Kodak and Wratten Plates.

### **OVERCOATING**

A THIN transparent gelatin layer is applied over the emulsion to protect it from abrasion. All Kodak film packs, miniature films, and the small roll film sizes are overcoated.

### **NONCURLING BACKING**

A GELATIN layer is applied to the back of the film base. The shrinkage of this layer compensates for that of the emulsion and thus prevents severe curling of the film.

### **ANTIHALATION FEATURE**

LIGHT penetrating an emulsion may reflect from the back of the base and strike the emulsion once more, causing halation around the image of bright objects. Antihalation base or backing is designed to absorb such light and prevent halation. While the emulsion itself absorbs much of the light striking it, Kodak negative materials are treated in various ways to insure good antihalation properties.

In the case of some orthochromatic materials, the antihalation feature is a magenta dye applied in the noncurling layer. This absorbs any blue, and green light which might penetrate to the base. With some panchromatic materials, a green layer of dye is used to absorb red, blue, and a good deal of the green light. The chemical composition of backing dyes is such that they bleach out completely in a properly compounded developer and fixing bath.

Incorporated in the base of Kodak 35-mm. Film is a blue-gray dye. Light transmitted by the emulsion must pass through the dye twice in order to get back to the emulsion and cause halation. The blue-gray dye is therefore twice as effective as it would at first appear. This dye does not bleach out in the processing solutions, but its presence has no effect on printing quality.

## **SHEET FILM NOTCHING CODE**

KODAK sheet films carry a series of identification notches as indicated in the Data Sheets. These not only tell the type of film but also identify the emulsion side of the film in the dark.

When the notches are on the right side of the top edge, the emulsion side of the film faces the operator. The notches are to be found on the short side of the sheet of film.

## **Exposure**

THREE methods of determining exposure settings are generally employed by camera users: 1, estimation based on experience; 2, exposure tables and guides; 3, photoelectric and other exposure meters.

## **EXPOSURE GUIDES**

OF the various means for obtaining correctly exposed pictures, the Eastman Kodak Company has chosen to provide exposure tables and dial-type guides. These tables and guides have been derived with great care from exhaustive practical tests and from extensive data on illumination, subject brightness, film speed, and print-making requirements. The principles involved have been confirmed by a number of years' experience. For any picture-taking situation specifically covered by a Kodak exposure guide, the camera settings indicated by the guide will yield an extremely high percentage of excellent photographs.

Kodak exposure guides for black-and-white negative materials are based on the recording of important shadow detail. The exposures indicated by the guides for daylight include a safety factor of 4x; that is, for a normal subject photographed under normal conditions, the exposure recommended is about two stops greater than the least exposure required for a negative that will produce an excellent print. However, less exposure should not be given unless picture-taking conditions demand it and the photographer is thoroughly familiar with all the factors involved. A smaller safety factor is used in Kodak exposure guides for artificial light, because there is less variation in illumination and subject matter in indoor photography than in outdoor photography.

Exposure guides for color films and black-and-white reversal materials are based essentially upon the quality obtained in the important highlight areas of a photograph, since the rendering of the highlights is much more critical in color and reversal processes than in black-and-white negative-making. Because these materials have limited exposure latitude, little or no safety factor can be included in the exposure

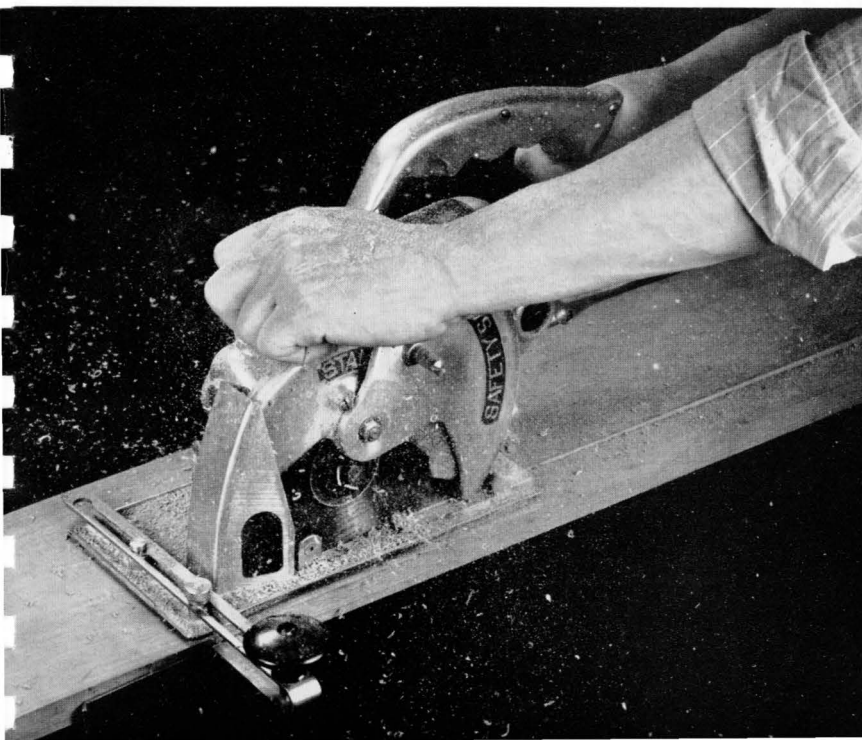
guides. The guides should be followed strictly unless experience with certain equipment dictates a consistent change.

The dial-type exposure calculators and other pocket-size guides supplied by the Eastman Kodak Company are called Kodaguides, and cover the use of a variety of films for both outdoor and indoor subjects. In addition to exposure data, certain guides, notably the Kodak and Kodachrome Indoor Guides, offer valuable assistance in lighting technique. Other Kodaguides aid in the selection of negative material, filters, and papers. Certain of the guides are supplied with Kodak cameras and all are sold by Kodak dealers.

## EXPOSURE METERS

PHOTOELECTRIC exposure meters are used widely and are of real help when their principles are thoroughly understood. The derivation of exposure indexes for use with exposure meters has been discussed in the section on film speeds. Recommended exposure indexes are included in the Data Sheets.

**A commercial subject photographed with the Kodatron Speedlamp**



## Storage of Photographic Materials

PROPER storage of films, plates, and papers is important because (1) heat and moisture accelerate deterioration, (2) exposure to various gases, x-rays, or radium can cause serious harm, (3) careless handling can destroy the protection afforded by the package, and damage film packs or motion-picture reels beyond use, (4) nitrate films are dangerous if overheated or exposed to open flame.

### UNEXPOSED MATERIAL IN DOMESTIC PACKING

"Domestic Packing" refers to the ordinary methods of packing photographic materials for shipment and sale in the United States. These packages afford protection against physical damage, and some protection against moisture, but in most cases are not vaportight. Materials in domestic packing require the following storage precautions:

1. Protection against excessive heat. Sensitized photographic materials must never be placed near steampipes or other sources of heat, or left on the top floor of uninsulated buildings, or in the glove compartment of an automobile. In the tropics, and during summer heat in temperate zones, refrigerated storage is recommended, especially for high-speed films, color films, and infrared materials. An ordinary household electric refrigerator is excellent for film storage, providing the film is placed in a tightly closed can or jar.

Recommended storage temperatures are as follows:

For storage periods up to:	2 MONTHS	6 MONTHS	12 MONTHS
Keep films and plates below:	75°F.	60°F.	50°F.
For papers, dry storage below 70°F. assures satisfactory keeping until the expiration date. <b>Caution:</b> <i>Film kept in cold storage should be removed 24 hours before packages are to be opened, to avoid condensation of moisture on the cold film.</i>			

2. Protection against moist air. Photographic materials should be stored in dry places, never in damp basements or other humid locations. The amount of moisture they absorb is determined by the *relative humidity* of the air (not the absolute humidity). Relative humidity is best measured with wet and dry bulb thermometers. Photographic materials should be stored at relative humidities between 40 and 60 per cent. Relative humidities below 40 per cent seldom cause trouble, but humidities even a little above 60 per cent may cause serious damage, especially if accompanied or followed by high temperatures.

Unless air is dried, relative humidity is higher at lower temperatures. Therefore, in refrigerated storage, temperature should not be lowered enough to cause relative humidity to exceed 60 per cent. In regions of high relative humidity, air in re-

refrigerators should be dried either by allowing circulation to the freezing coils, where moisture will be condensed, or by some other method of desiccation. Where no such method is possible, the only alternative is to place the sensitized material in a vaportight container (such as a tightly closed can or jar) inside the refrigerator.

3. Protection against possibility of exposure to harmful gases such as formaldehyde, industrial gases, motor exhaust, and solvent vapors.

4. In hospitals or industrial plants, protection against x-rays and radium. This is afforded by lead-lined storage cabinets.

5. For films marked NITRATE, protection against fire hazard. Such films should be stored separately in vented cabinets which conform to regulations of the National Fire Protection Ass'n., 60 Batterymarch Street, Boston, Mass. Other films do not require fireproof storage.

## **UNEXPOSED MATERIAL IN TROPICAL PACKING**

Tropical packing is available upon order for photographic materials which are to be taken into the tropics or other locations where excessive humidity is encountered. Tropical packing is strongly resistant to moisture and gases, but does not provide protection against heat; therefore, the same temperature precautions should be observed as with domestic packing.

To retain the protection of the tropical packing as long as possible, these packages should not be opened until the materials are to be used. After the tropical packing has been opened, the materials should be exposed and processed immediately. If immediate processing is not convenient, the exposed materials must be kept as cool and dry as possible. Such materials must not be resealed in tropical packing unless they can first be dried by means of a suitable desiccating agent. Drying methods are described under *Storage of Kodachrome Film* in the Color Films section of the Kodak Reference Handbook, and in the Kodak Data Book, *Kodachrome and Kodacolor Film*.

## **STORAGE OF PROCESSED MATERIALS**

To ensure maximum life, developed films, plates, and papers should be thoroughly fixed and washed. Storage should be in a cool, dry place, to reduce the possibility of decomposition of emulsion or support, and to avoid the possibility of growth of mold or fungus.

Since the silver image may be attacked by certain sulfur compounds, the materials should be protected against fumes of hydrogen sulfide and coal gas. Papers and adhesives not specially made for photographic purposes should not be used in contact with the emulsion, since they may contain traces of harmful substances which will cause a picture to fade. Specially prepared envelopes are available for negative storage.

## SPEED AND DEVELOPMENT DATA FOR KODAK PLATES

KODAK AND WRATTEN PHOTOGRAPHIC PLATES	Kodak Speed	Exposure Index*		Exposure Meter Settings for Copying (Tungsten)**			Recommended Developers and Developing Times at 68° F. (20° C.)—Tank	Wratten Safelight Series
		Day light	Tung- sten	Continuous Tone*	Line			
					Weston	G.E.		
NON-COLOR-SENSITIZED Kodak 40 Kodak 33 Kodak 33 Matte Kodak Process  Kodak Lantern Slides Medium  Contrast Anti-Abrasion Contrast }	0125 080 080	32 20 20	8 5 5	1.2 1.2	1.2	2.0	{ DK-50 (1:1), 10 min.; D-61a (1:3), 12 min.; D-7 (1:1:1:13), 8 min.  D-8 (2:1), 2 min. (tray); D-11, 5 min.	1
	7x speed of Kodabromide Paper No. 2						{ D-72 (1:2), 1-3 min. (tray) Warm tones: D-32, 5 min. (tray) Soft results: DK-50, 2-3 min. (tray) D-72 (1:2), 2-6 min. (tray) High contrast: D-11, 5 min. (tray)	1
	25x speed of Kodabromide Paper No. 4							
ORTHOCHROMATIC Kodak Super Ortho-Press  Kodak 50 Kodak Polychrome Kodak Commercial Wratten Metallographic Kodaline	0400 0125 0125 080	100 32 32 20	50 12 10 10		16 0.12	24 0.2	{ Press: DK-60a, 5 min.; D-72 (1:1), 3½ min.; D-19, 4 min. Commercial: DK-60a, 4 min.; DK-50, 6 min.  { DK-50 (1:1), 1½ min.; D-61a (1:3), 12 min.; D-7 (1:1:1:13), 8 min.  { Low to normal contrast: D-41†. High contrast: D-42†, DK-50†. Extreme contrast: D-19†. Kodalith Dev., 2¼ min.; D-85, 2 min.	2
PANCHROMATIC TYPE B Kodak Tri-X Pan, Type B Kodak Tri-X Pan, Matte, Type B Kodak Panatomic-X Wratten Pan  Wratten Process Pan Wratten M	{ 0640 0160 064	160 40 16	100 25 10	25 6 2.5	20 16	32 24	{ General photography: DK-50, 5 min. Color separation: DK-50†, D-76†. DK-50, 5 min.; D-76, 14 min.; DK-60a, 4 min. D-76, 9 min.; High contrast: D-11 (1:1), 4 min.  D-11, 5 min. High contrast: D-8 (2:1), 2 min. (tray) Low to normal contrast: D-41†. High contrast: D-42†, DK-50†. Extreme contrast: D-19†.	3
PANCHROMATIC TYPE C Kodak Super Panchro-Press	0400	100	80				{ Press: DK-60a, 5 min.; D-72 (1:1), 3½ min.; D-19, 4 min. Commercial: DK-60a, 4 min.; DK-50, 6 min.	3
INFRARED SENSITIVE Kodak Infrared-Sensitive			5††	1.2††			D-19 (1:4), 4 min.; D-11 (1:1), 5 min.	7

\*These values are suitable for use with Weston and General Electric exposure meters and supersede values previously recommended.

\*\*For copying only. Based on the normal position of the calculator being set at the reading obtained from a white surface in the copying position.

†Development times given on instruction sheet enclosed with plate.

††With Wratten No. 25 Filter.

# Data—KODAK VERICHROME ROLL FILM AND FILM PACKS

**General Properties:** A high-speed, orthochromatic film for general outdoor use. Also suitable for night photography with Photoflash Lamps.

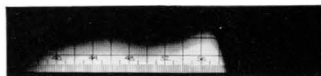
**Film Exposure Index:** Daylight **50** Tungsten **25**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Orthochromatic.



BLUE GREEN RED  
Spectrogram to Sunlight



BLUE GREEN RED  
Spectrogram to Tungsten Light

## Filter Factors:

FILTER	K1	K2	K3	G	B	C5	KODAK POLA-SCREEN
Sunlight	2	2.5	2.5	5	8	3	2.5
Tungsten	1.5	2	2	3	4.5	3.5	2.5

## Daylight Exposure Table: Lens Apertures at 1/50 Second

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>
Bright	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>
Average	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Shaded	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>

**Brilliant Subjects:** Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground.

**Bright Subjects:** People in marine, beach, or snow scenes; scenics with foreground objects.

**Average Subjects:** Nearby people, gardens, houses, and scenes **not in the shade**.

**Shaded Subjects:** Subjects in **open shade** (not under trees, porch roof, etc.)

**Photoflood Exposure Table:** One No. 1 Photoflood *near camera axis* and one No. 2 Photoflood as *side light* in Kodak Handy Reflectors or Kodaflector Senior (matte side).

Distance, lamps-to-subject	3½'	4½'	5½'	7'	8'	9'
Aperture at 1/25 sec.	<i>f/8</i>	<i>f/6.3</i>	<i>f/5.6</i>	<i>f/4.5</i>	<i>f/4</i>	<i>f/3.5</i>

**Photoflash Exposures** for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodak Handy Reflector at:	8½'	12'	17'	24'	34'	
Lens aperture for open-flash exposures:	<i>f/32</i>	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	
GUIDE EXPOSURE NUMBERS*		SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.		—	130	145	220	—
Kodak Junior Synchronizer—1/50 sec.		80	155	—	—	—
Focal-plane shutter synchronizers—1/100 sec.		—	—	—	—	90
*Divide by distance in feet from lamp to subject to find <i>f</i> -number.						

\*Divide by distance in feet from lamp to subject to find *f*-number.

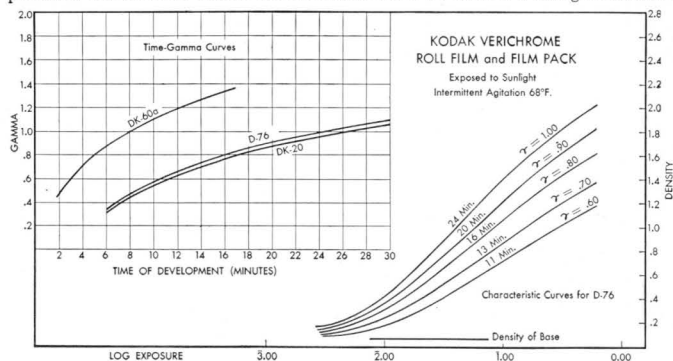
**Contrast:** Recommended development in Kodak D-76 yields gamma of approximately 0.85; greater or less contrast obtained by longer or shorter development time.

**Recommended Development:**

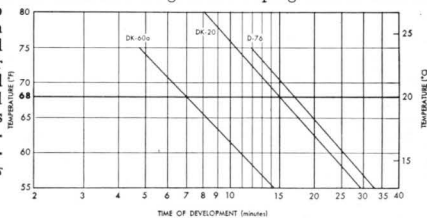
KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
D-76	Amateur	13 minutes	17 minutes
Versatol	Amateur	(1:3) 5 minutes	(1:7) 10 minutes
Microdol	Fine grain	13 minutes	16 minutes
DK-20	Fine grain	12 minutes	15 minutes
DK-60a	Photofinishing	5½ minutes	7 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Medium, permits considerable enlargement without objectionable grain.

**Resolving Power:** 45 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development in Kodak D-76.

**Fixing:** Rinse thoroughly in water; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 2 (deep red).

**Rolls and Packs Available:** All regularly listed rolls and packs.

**24 KODAK FILMS**



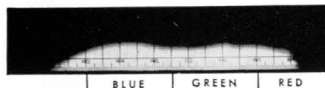
# Data—KODAK PLUS-X PANCHROMATIC ROLL FILM AND FILM PACKS

**General Properties:** High speed, fine grain, excellent gradation, wide exposure latitude. The speed and balanced color sensitivity make this film particularly suited to a wide range of outdoor conditions. It also has ample speed for well-lighted indoor subjects. The low graininess and high resolving power permit high quality enlargements many times the size of the original negative.

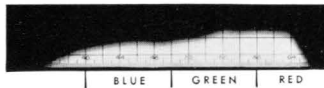
**Film Exposure Index:** Daylight **50** Tungsten **32**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

FILTER	K2	G	X1	A	B	C5	KODAK POLA-SCREEN
Sunlight	2	3	4	7	6	5	2
Tungsten	1.5	2	3	4	6	10	2

**Daylight Exposure Table:** Lens Apertures at 1/50 Second.

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>
Bright	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>
Average	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Shaded	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>

**Brilliant Subjects:** Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground.

**Bright Subjects:** People in marine, beach, or snow scenes; scenics with foreground objects.

**Average Subjects:** Nearby people, gardens, houses, and scenes **not in the shade**.

**Shaded Subjects:** Subjects in **open shade** (not under trees, porch roof, etc.)

**Photoflood Exposure Table:** One No. 1 Photoflood *near camera axis* and one No. 2 Photoflood as *side light* in Kodak Handy Reflectors or Kodaflector Senior (matte side).

Distance, lamps-to-subject	3½'	4½'	5½'	7'	8'	9'
Aperture at 1/25 sec.	<i>f/8</i>	<i>f/6.3</i>	<i>f/5.6</i>	<i>f/4.5</i>	<i>f/4</i>	<i>f/3.5</i>

**Photoflash Exposures** for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodak Handy Reflector at:	8½'	12'	17'	24'		
Lens aperture for open-flash exposures:	<i>f/32</i>	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>		
GUIDE EXPOSURE NUMBERS*		SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.		—	140	155	235	—
Kodak Junior Synchronizer—1/50 sec.		85	165	—	—	—
Focal-plane shutter synchronizers—1/100 sec.		—	—	—	—	95

\*Divide by distance in feet from lamp to subject to find *f*-number.

\*Divide by distance in feet from lamp to subject to find *f*-number.

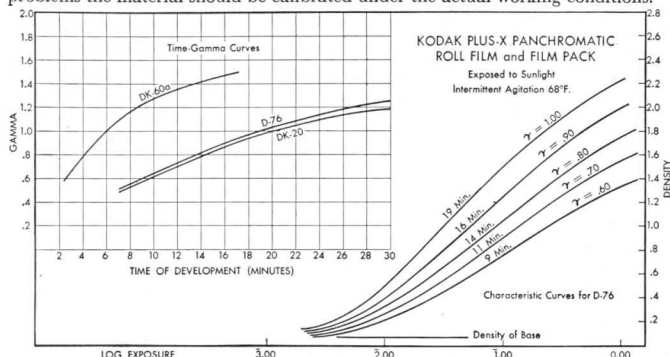
**Contrast:** Recommended development in Kodak D-76 yields gamma of approximately 0.9; maximum practical gamma with Kodak DK-60a about 1.5.

**Recommended Development:**

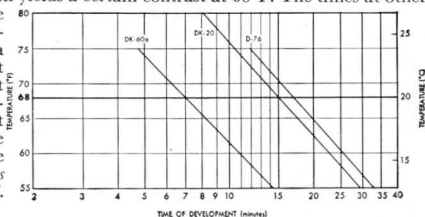
KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
D-76	Amateur	13 minutes	17 minutes
Versatol	Amateur	(1:3) 5 minutes	(1:7) 10 minutes
DK-60a	Photofinishing	5½ minutes	7 minutes
Microdol	Fine grain	13 minutes	16 minutes
DK-20	Fine grain	12 minutes	15 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves:** Each development time recommended above for intermittent agitation yields a certain contrast at 68°F. The times at other temperatures to yield the same contrast are given by the diagonal lines on this chart. For a different contrast, or different agitation, find the time at 68°F., and through the corresponding point on the chart draw a new diagonal line parallel to the one for the developer in use. *Best results are obtained at 65°F. to 70°F.*



**Graininess:** Low, permits enlargements to 10 or more diameters without objectionable graininess when developed in Kodak D-76. **Resolving Power:** For optimum exposure, subject contrast 30:1, recommended dev. in Kodak D-76; 50 lines per mm.

**Fixing:** Rinse thoroughly in water; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred. Wratten Series 3, with 10-watt bulb, at not less than 3 feet, can be used for a few seconds after development is half complete.

**Rolls and Packs Available:** Roll Films: PX127, PX120, PX620, PX116, PX616, and PX122. Film Packs: PX520, PX518, PX541, and PX523.

# Data—KODAK SUPER-XX

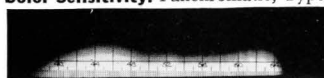
## PANCHROMATIC ROLL FILM AND FILM PACKS

**General Properties:** Very high speed, for indoor and outdoor use under adverse lighting conditions. Especially valuable for use with artificial light. With Photoflood Lamps, permits instantaneous exposures with simple lens cameras.

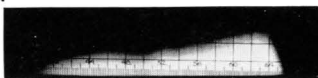
**Film Exposure Index:** Daylight **100** Tungsten **80**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type C.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, X1; Tungsten, X2.)

FILTER	K2	G	X1	X2	A	B	C5	KODAK POLA-SCREEN
Sunlight	2	2.5	5		4	7	5	
Tungsten	1.5	2	4	5	2	6	10	2

**Daylight Exposure Table:** Lens Apertures at 1/100 Second

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>
Bright	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>
Average	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Shaded	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>

**Brilliant Subjects:** Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground.

**Bright Subjects:** People in marine, beach or snow scenes; scenics with foreground objects.

**Average Subjects:** Near-by people, gardens, houses and scenes **not in the shade**.

**Shaded Subjects:** Subjects in **open shade** (not under trees, porch, roof, etc.).

**Photoflood Exposure Table:** One No. 1 Photoflood *near camera axis* and one No. 2 Photoflood *as side light* in Kodak Handy Reflectors or Kodaflector Senior (matte side).

Distance, lamps-to-subject	3½'	5½'	7'	8'	10'	11'	13'
Aperture at 1/25 sec.	<i>f/11</i>	<i>f/8</i>	<i>f/6.3</i>	<i>f/5.6</i>	<i>f/4.5</i>	<i>f/4</i>	<i>f/3.5</i>

**Photoflash Exposures** for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodak Handy Reflector at:	14'		20'		28'	
Lens aperture for open-flash exposures:	<i>f/32</i>		<i>f/22</i>		<i>f/16</i>	
GUIDE EXPOSURE NUMBERS*		SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.		—	225	255	380	—
Kodak Junior Synchronizer—1/50 sec.		140	270	—	—	—
Focal-plane shutter synchronizers—1/100 sec.		—	—	—	—	155

\*Divide by distance in feet from lamp to subject to find *f*-number.

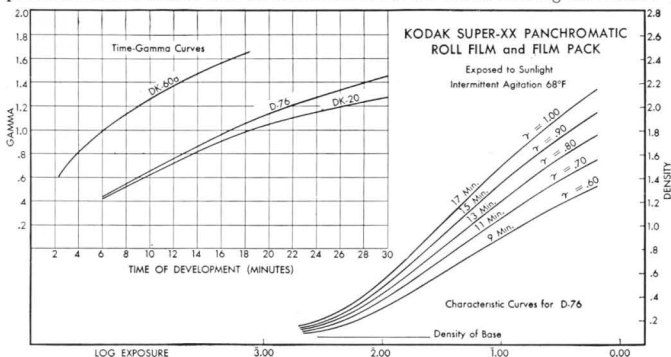
**Contrast:** Recommended development in D-76 gives gamma of approximately 1.0; more or less contrast obtained by longer or shorter development time.

**Recommended Development:**

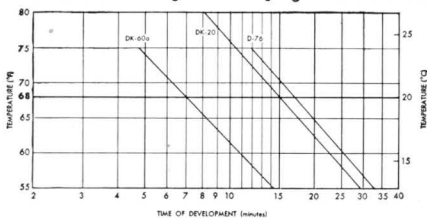
KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
D-76	Amateur	13 minutes	17 minutes
DK-60a	Photofinishing	5½ minutes	7 minutes
Versatol	Amateur	(1:3) 5 minutes	(1:7) 10 minutes
Microdol	Fine grain	13 minutes	16 minutes
DK-20	Fine grain	12 minutes	15 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Medium, permitting considerable enlargement for such a fast film.

**Resolving Power:** 45 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development in Kodak D-76.

**Fixing:** Rinse thoroughly in water; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3, 10-watt bulb, at 3 ft. for a few seconds after development is half complete.

**Rolls and Packs Available:** All popular sizes of roll films and film packs.

## Data—KODAK SUPER ORTHO-PRESS FILM PACKS

**General Properties:** A high speed, orthochromatic film pack intended particularly for press work. It is also useful for certain types of commercial work when the use of a non-panchromatic material is permissible or desirable.

**Film Exposure Index:** Daylight **100** Tungsten **50**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Orthochromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

### Filter Factors:

FILTER	K1	K2	K3	G	B	C5	KODAK POLA-SCREEN
Sunlight	2	2.5	2.5	5	8	3	2.5
Tungsten	1.5	2	2	3	4.5	3.5	2.5

### Daylight Exposure Table: Lens Apertures at 1/100 Second

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>
Bright	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>
Average	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Shaded	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>

**Brilliant Subjects:** Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground.  
**Bright Subjects:** People in marine, beach or snow scenes; scenics with foreground objects.  
**Average Subjects:** Near-by people, gardens, houses and scenes **not in the shade**.  
**Shaded Subjects:** Subjects in **open shade** (not under trees, porch, roof, etc.).

**Photoflash Outdoor Guide Exposure Numbers** for outdoors at night or large dark interiors: Divide by the distance in feet from lamp to subject to find *f*-number. For average subjects in average room with light-colored walls and ceilings, use double these guide exposure numbers.

GUIDE EXPOSURE NUMBERS	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	90	100	150	—
Kodak Junior Synchronizer—1/50 sec.	55	105	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	60

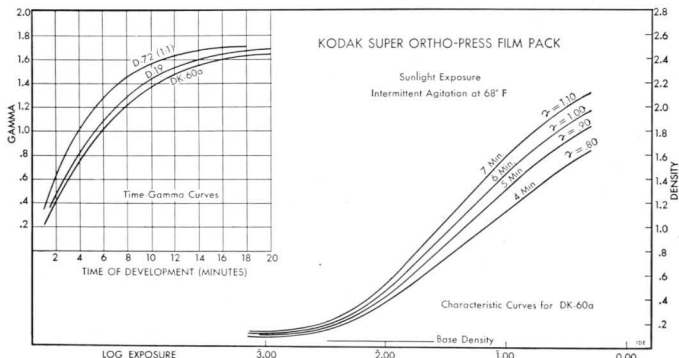
**Contrast:** Maximum practical gamma with Kodak D-19 about 1.6. A wide range of contrasts can be obtained by a choice of developer and development time. Recommended development for press photography gives a gamma of about 1.0.

## Recommended Development:

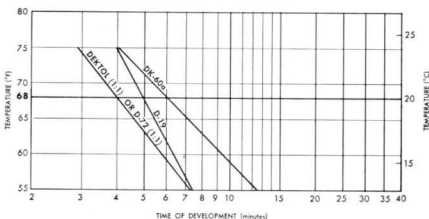
KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
DK-60a	General use	4½ minutes	6 minutes
D-19	General use	4 minutes	5 minutes
Dektol (1:1)	Rapid development	3 minutes	4 minutes
D-72 (1:1)	Rapid development	3 minutes	4 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves:** Each development time recommended above for continuous agitation yields a certain contrast at 68°F. The times at other temperatures to yield the same contrast are given by the diagonal line on this chart. For a different contrast, or different agitation, find the time at 68°F., and through the corresponding point on the chart draw a new diagonal line parallel to the one for the developer in use. Read the desired time from this new line. *Best results are obtained at 65°F. to 70°F.*



**Graininess:** Moderate. Allows enlargement without objectionable grain.

**Resolving Power:** 45 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 2 (deep red), at not less than 3 feet.

**Packs Available:** OP520, OP518, OP541, and OP523.

30 KODAK FILMS

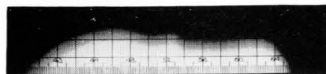
## Data—KODAK PLUS-X PANCHROMATIC FILM FOR MINIATURE CAMERAS (35-mm. and Bantam)

**General Properties:** High speed and fine grain. For general miniature camera work this film should be used unless light conditions are very adverse or unless a very high degree of enlargement is intended.

**Film Exposure Index:** Daylight **50** Tungsten **32**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

FILTER	K2	G	X1	A	B	C5	KODAK POLA-SCREEN
Sunlight	2	3	4	7	6	5	2
Tungsten	1.5	2	3	4	6	10	2

**Daylight Exposure Table:** Lens Apertures at 1/100 Second

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>
Bright	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Average	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>
Shaded	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>	<i>f/2</i>
<b>Brilliant Subjects:</b> Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground. <b>Bright Subjects:</b> People in marine, beach, or snow scenes; scenics with foreground objects. <b>Average Subjects:</b> Nearby people, gardens, houses, and scenes <b>not in the shade</b> . <b>Shaded Subjects:</b> Subjects in <b>open shade</b> (not under trees, porch roof, etc.)				

**Photoflood Exposure Table:** One No. 1 Photoflood *near camera axis* and one No. 2 Photoflood as *side light* in Kodak Handy Reflectors or Kodaflector Senior (matte side).

Distance, lamps-to-subject	3½'	4½'	5½'	7'	8'	9'	11'	16'
Aperture at 1/25 sec.	<i>f/8</i>	<i>f/6.3</i>	<i>f/5.6</i>	<i>f/4.5</i>	<i>f/4</i>	<i>f/3.5</i>	<i>f/2.8</i>	<i>f/2</i>

**Photoflash Exposures** for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodak Handy Reflector at:	8½'	12'	17'	24'	34'		
Lens aperture for open-flash exposures:	<i>f/32</i>	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>		
GUIDE EXPOSURE NUMBERS*		SM	No. 5	No. 11	No. 22	No. 6	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.		—	140	155	235	—	—
Kodak Junior Synchronizer—1/50 sec.		85	165	—	—	—	—
Kodak Ektra Synchronizer—1/100 sec.		—	—	—	—	—	95
Other focal-plane synchronizers—1/100 sec.		—	—	—	—	80	95

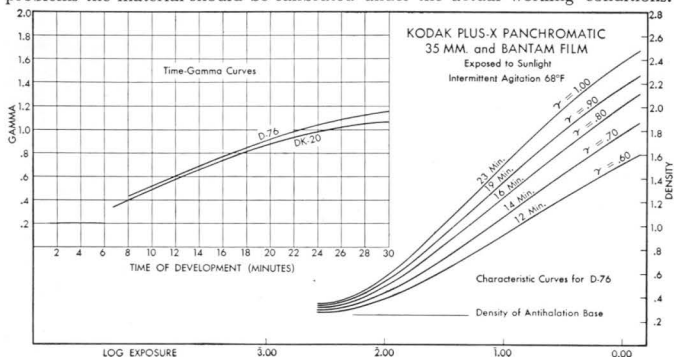
\*Divide by distance in feet from lamp to subject to find *f*-number.

**Contrast:** Recommended development in D-76 yields gamma of approximately 0.8. Maximum practical gamma with D-76 about 1.1.

**Recommended Development:**

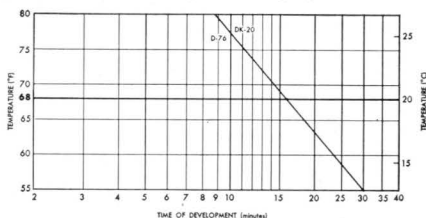
KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20°C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20°C.)
D-76 Microdol or DK-20	General purpose Fine grain	13 minutes 13 minutes	16 minutes 16 minutes
*Agitation at one-minute intervals during development.			

**Sensitometric Curves:** These data, applying to average products and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various

temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Low, permits enlargement to 10 or more diameters without objectionable graininess when developed in D-76.

**Resolving Power:** For optimum exposure, subject contrast 30 to 1, recommended development in Kodak D-76; 55 lines per mm.

**Fixing:** Rinse thoroughly in water; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3, 10-watt bulb, at 3 ft., for a few seconds after development is half complete.

**Rolls Available:** Bantam—PX828 roll. 35-mm.—PX135 magazine (18 or 36 exposures) and bulk 35-mm. rolls as follows: No. 410 (27½ ft.), No. 401 (50 ft.), No. 402 (100 ft.), and No. 403 (200 ft.).



# Data—KODAK PANATOMIC-X FILM FOR MINIATURE CAMERAS (35-mm. and Bantam)

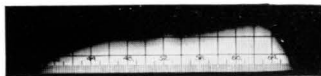
**General Properties:** Extremely fine grain, moderate speed, particularly valuable when great enlargement is intended or when extreme detail or texture is desired. Useful for contact negatives from Kodachrome transparencies.

**Film Exposure Index:** Daylight **25** Tungsten **16**.  
These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

FILTER	K2	G	X1	A	B	C5	KODAK POLA-SCREEN
Sunlight	2	3	4	7	6	5	2
Tungsten	1.5	2	3	4	6	10	2

**Daylight Exposure Table:** Lens Apertures at 1/100 Second

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Bright	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>
Average	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>	<i>f/2</i>
Shaded	<i>f/4</i>	<i>f/2.8</i>	<i>f/2</i>	

**Brilliant Subjects:** Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground.  
**Bright Subjects:** People in marine, beach, or snow scenes; scenics with foreground objects.  
**Average Subjects:** Nearby people, gardens, houses, and scenes **not in the shade**.  
**Shaded Subjects:** Subjects in **open shade** (not under trees, porch roof, etc.)

**Photoflood Exposure Table:** One No. 1 Photoflood *near camera axis* and one No. 2 Photoflood as *side light* in Kodak Handy Reflectors or Kodaflector Senior (matte side).

Distance, lamps-to-subject	3¼'	3½'	4½'	5½'	6½'	8'	11'
Aperture at 1/25 sec.	<i>f/6.3</i>	<i>f/5.6</i>	<i>f/4.5</i>	<i>f/4</i>	<i>f/3.5</i>	<i>f/2.8</i>	<i>f/2</i>

**Photoflash Exposures** for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodak Handy Reflector at:	7'	10'	14'	20'	28'
Lens aperture for open-flash exposures:	<i>f/32</i>	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 6	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	95	105	155	—	—
Kodak Junior Synchronizer—1/50 sec.	60	110	—	—	—	—
Kodak Ektra Synchronizer—1/100 sec.	—	—	—	—	—	65
Other focal-plane synchronizers—1/100 sec.	—	—	—	—	50	65

\*Divide by distance in feet from lamp to subject to find *f*-number.

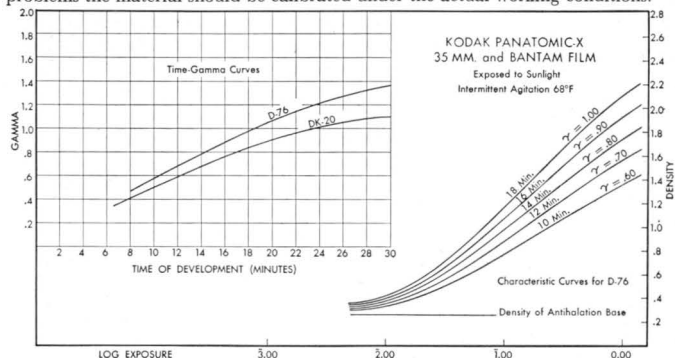
**Contrast:** Recommended development yields gamma of approximately 0.8. Maximum practical gamma with D-76 about 1.3.

**Recommended Development:**

KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20°C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20°C.)
D-76	General purpose	11 minutes	14 minutes
Microdol	Extremely fine grain	12 minutes	15 minutes
DK-20	Extremely fine grain	11 minutes	14 minutes

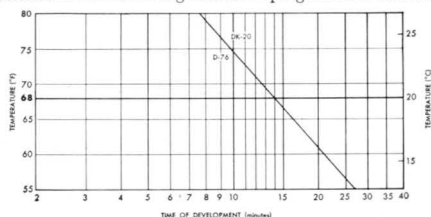
\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various

temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Extremely low even without special fine-grain processing. Permits great enlargement without noticeable grain.

**Resolving Power:** For optimum exposure, subject contrast 30 to 1, recommended development in Kodak D-76; 60 lines per mm.

**Fixing:** Rinse thoroughly in water; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3, 10-watt bulb, at 3 ft., for a few seconds after development is half complete.

**Rolls Available:** Bantam—FX828 roll. 35-mm.—FX135 magazine (18 or 36 exposures) and bulk 35-mm. rolls as follows: No. 410 (27½ ft.), No. 401 (50 ft.), No. 402 (100 ft.), and No. 403 (200 ft.).

# Data—KODAK SUPER-XX PANCHROMATIC FILM FOR MINIATURE CAMERAS (35-mm. and Bantam)

**General Properties:** Very high speed; for indoor and outdoor use under adverse lighting conditions and where very fast shutter speeds are necessary. Especially valuable for exposures by artificial light.

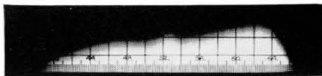
**Film Exposure Index:** Daylight **100** Tungsten **64**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. The Daylight value is the same as the ASA Film Exposure Index as specified by the American Standards Association. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

FILTER	K2	G	X1	A	B	C5	KODAK POLA-SCREEN
Sunlight	2	3	4	7	6	5	2
Tungsten	1.5	2	3	4	6	10	2

**Daylight Exposure Table:** Lens Apertures at 1/100 Second

SUBJECT TYPE	BRIGHT SUN	HAZY SUN	CLOUDY-BRIGHT	CLOUDY-DULL
Brilliant	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>
Bright	<i>f/16</i>	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>
Average	<i>f/11</i>	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>
Shaded	<i>f/8</i>	<i>f/5.6</i>	<i>f/4</i>	<i>f/2.8</i>

**Brilliant Subjects:** Beach, marine, and snow scenes, distant landscapes and mountains without prominent dark objects in the foreground.

**Bright Subjects:** People in marine, beach, or snow scenes; scenics with foreground objects.

**Average Subjects:** Nearby people, gardens, houses, and scenes **not in the shade**.

**Shaded Subjects:** Subjects in **open shade** (not under trees, porch roof, etc.)

**Photoflood Exposure Table:** One No. 1 Photoflood *near camera axis* and one No. 2 Photoflood as *side light* in Kodak Handy Reflectors or Kodaflector Senior (matte side).

Distance, lamps-to-subject	3½'	5½'	7'	8'	10'	11'	13'	16'	23'
Aperture at 1/25 sec.	<i>f/11</i>	<i>f/8</i>	<i>f/6.3</i>	<i>f/5.6</i>	<i>f/4.5</i>	<i>f/4</i>	<i>f/3.5</i>	<i>f/2.8</i>	<i>f/2</i>

**Photoflash Exposures** for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodak Handy Reflector at:	12'	17'	24'	34'			
Lens aperture for open-flash exposures:	<i>f/32</i>	<i>f/22</i>	<i>f/16</i>	<i>f/11</i>			
GUIDE EXPOSURE NUMBERS*		SM	No. 5	No. 11	No. 22	No. 6	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.		—	195	220	330	—	—
Kodak Junior Synchronizer—1/50 sec.		125	235	—	—	—	—
Kodak Ektra Synchronizer—1/100 sec.		—	—	—	—	—	135
Other focal-plane synchronizers—1/100 sec.		—	—	—	—	110	135
*Divide by distance in feet from lamp to subject to find <i>f</i> -number.							

\*Divide by distance in feet from lamp to subject to find *f*-number.

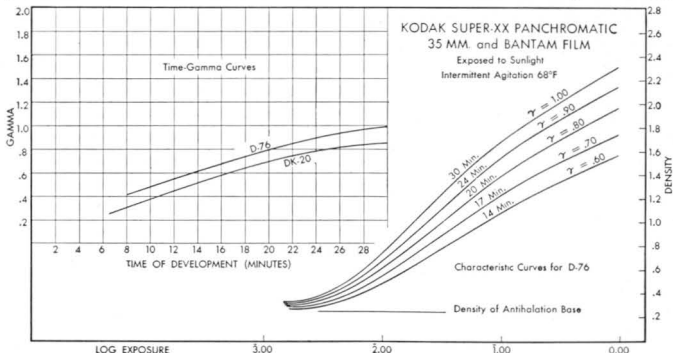
**Contrast:** Recommended development gives gamma of approximately 0.8; more or less contrast can be obtained by longer or shorter development time.

**Recommended Development:**

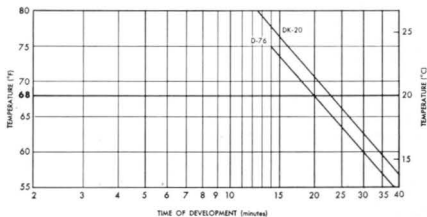
KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
D-76	General purpose	16 minutes	20 minutes
Microdol	Extremely fine grain	16 minutes	20 minutes
DK-20	Extremely fine grain	18 minutes	23 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Medium, permitting considerable enlargement.

**Resolving Power:** For optimum exposure, subject contrast 30 to 1, recommended development in Kodak D-76; 50 lines per mm.

**Fixing:** Rinse thoroughly in water; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3, 10-watt bulb, at 3 ft., for a few seconds after development is half complete.

**Rolls Available:** Bantam—XX828 roll. 35-mm.—XX135 magazine (18 or 36 exposures) and bulk 35-mm rolls as follows: No. 410 (27½ ft.), No. 401 (50 ft.), No. 402 (100 ft.), and No. 403 (200 ft.).

## 36 KODAK FILMS

## Data—KODAK INFRARED FILM (*Miniature and Roll*)

**General Properties:** Sensitive to infrared radiation in addition to the normal blue-violet sensitivity. With orange or red filter, it records objects by the infrared radiation, often giving striking and unusual effects. Most commonly used for distant landscape photography, to produce detail ordinarily obscured by atmospheric haze. Also useful in medical, documentary, and other scientific fields of photography and photomicrography.

### Film Exposure Index: Tungsten 8.

This value applies for exposure through the Wratten A Filter (No. 25). It is suitable for use with Weston and General Electric Exposure Meters and supersedes meter settings previously recommended.

No settings are given for daylight since the ratio of infrared to visible radiation in daylight varies considerably, and meters respond principally to visible light, but this ratio for tungsten light is sufficiently constant to warrant use of a meter.

**Color Sensitivity:** Blue-violet and infrared.



**Filters:** To obtain infrared effect a filter must be used. The Wratten A Filter (No. 25) is recommended. Other Wratten Filters can also be used, Nos. 29 or 70, which require the same exposure as the No. 25; Nos. 88, 89, or 89a, which require about 1.5 times the exposure; and Nos. 87 or 88a, which require double the exposure.

**Daylight Exposures:** Open Landscapes, Summer Sunlight.

<i>Exposed Through Wratten A Filter Subject in Bright Sunlight</i>		<i>Without Filter, for Ordinary (Blue Sensitive) Rendering in Bright Sunlight</i>
DISTANT SCENES	NEARBY SCENES	DISTANT SCENES
1/25 at f/8	1 second at f/22 or 1/10 at f/6.3	1/50 at f/16

**Photoflood Exposures:** With Wratten A, G, or F Filter and for 2 No. 1 Photoflood Lamps, dark-colored subjects. For light-colored subjects, use one stop smaller.

LAMP DISTANCE	LAMPS IN KODAFLECTORS	LAMPS IN KODAK HANDY REFLECTORS
3 ft.	f/11, $\frac{1}{2}$ sec.	f/8, $\frac{1}{2}$ sec.
5 ft.	f/8, $\frac{1}{2}$ sec.	f/5.6, $\frac{1}{2}$ sec.

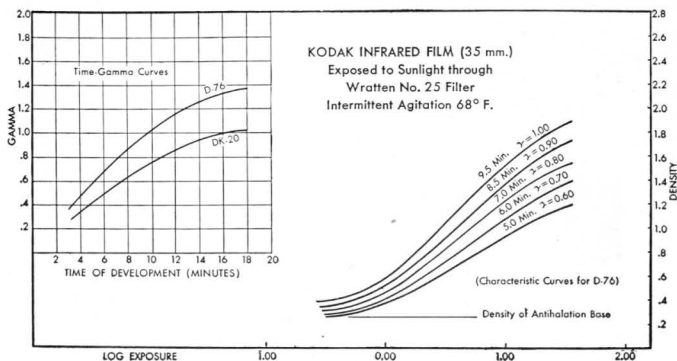
**Contrast:** Recommended development in Kodak D-76 gives a gamma of approximately 0.9; in DK-20 about 0.7.

### Recommended Development:

KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
D-76 Microdol or DK-20	General Fine grain	7 minutes 8 minutes	9 minutes 10 minutes

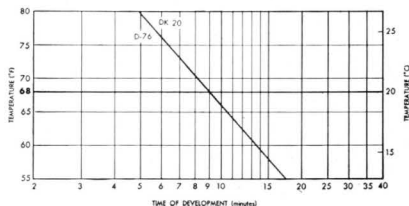
\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These curves apply to exposure to sunlight through the Wratten A (No. 25) Filter, and for development in fresh developer at 68°F. with intermittent agitation. The base density for IR828 film and for larger roll films is 0.05, rather than 0.24 as shown for the IR135 film. All points on all the characteristic curves for the former, therefore, are 0.19 lower in density than the curves shown. Time-Gamma curves are not affected. These data are for average product and average processing and are sufficiently accurate for all ordinary photographic work. For special problems, the material should be calibrated under the actual working conditions.



### Time-Temperature Development Curves:

Showing the developing times at various temperatures corresponding to the times at 68°F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68°F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Handle in total darkness, or use a Wratten Safelight Series 7 (Infrared) with a 10-watt bulb in a suitable safelight lamp at not less than 3 feet. Other Wratten Safelights *cannot be used* with infrared materials because they transmit infrared radiation.

**Rolls Available:** Bantam—IR828 roll, 35-mm.—IR135 magazine (36 exposures), and No. 401 (50 ft.) roll. Roll Films (6 exposures)—IR116, IR616, IR120, IR620, IR127.

# Data—KODAK DIRECT POSITIVE PANCHROMATIC FILM

**General Properties:** This is a fast panchromatic film of low graininess which, by special reversal processing, gives black-and-white slide transparencies of the highest quality directly on the material exposed in the camera. It has a safety base and an antihalation backing. Since this film is processed by reversal, fewer operations and less time are required in making slides than in making negatives and printing from them. The resulting transparencies can be tinted and toned like other slide materials.

All ordinary subjects such as landscapes, architecture, group pictures, informal indoor close-ups, can be photographed with this film. It is adaptable to photomicrographic and other technical work and also to making 2 x 2-inch slides by copying methods and by reduction from 3½ x 4-inch slides. The originals can be black and white or colored, and filters can be used. The film is not designed, however, to yield the extreme contrast required for the best line copying. Paper prints can be obtained from intermediate negatives made from the transparencies.

**Recommended Meter Settings:** The following tables of meter settings and exposure data apply only if the film is processed precisely as recommended; temperature, time, and agitation are particularly important.

EXPOSURE METER SETTINGS	WESTON		G. E.	
	DAYLIGHT	TUNGSTEN	DAYLIGHT	TUNGSTEN
Kodak Direct Positive Panchromatic Film	50	40	80	64

**Meter Settings for Copying Continuous-Tone Originals:** Based on normal position of calculator being set at the reading obtained from a white surface in the copying position.

Continuous-Tone, White-Card Meter Settings	WESTON		G. E.	
	DAYLIGHT	TUNGSTEN	DAYLIGHT	TUNGSTEN
Kodak Direct Positive Panchromatic Film	12	10	20	16

**Daylight Exposure Table—LENS APERTURES AT 1/100 SEC. SHUTTER SPEED**

Lighting	Average Subjects	Light- Colored Subjects	Dark- Colored Subjects	Side- Lighted Subjects	Back- Lighted Subjects
Bright, Direct Sunlight	f/11	f/11-f/16	f/8-f/11	f/8	f/5.6
Weak, Hazy Sun, No Distinct Shadows Cast	f/8	f/8-f/11	f/5.6-f/8		
Sky Overcast, Cloudy, but Bright, or Open Shade on Bright Day	f/5.6	f/5.6-f/8	f/4-f/5.6		
In Shade on Bright Day	f/4	f/4-f/5.6	f/3.5		

**Photoflood Exposure Table—No. 1 PHOTOFLOODS IN KODAK HANDY REFLECTORS**

Shutter Speed in Seconds	Number of Lamps	Distance from Lamps to Subject in Feet					
		f/3.5	f/4.5	f/5.6	f/6.3	f/8	f/8-f/11
1/25	1	4	3				
	2	6	4	3¼	3		
	3	7	5	4	3½	3¼	
	4	8	6	4¾	4	3¾	3
1/5	1	9	6½	5½	4½	4½	3¼
	2	13	9½	7½	6½	6	4¾
	3	16	11½	9	8	7½	5½
	4	19	13	11	9½	8½	6½

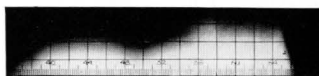
PHOTOFLASH EXPOSURE TABLE—ONE NO. 22 PHOTOFLASH LAMP IN KODAK HANDY REFLECTOR							
Distance, lamps-to-subject Aperture (open flash)	6'	8'	12'	16'	23'	29'	33'
	f/32	f/22	f/16	f/11	f/8	f/6.3	f/5.6

**Color Sensitivity:** Panchromatic, Type C.



BLUE GREEN RED

Spectrogram to Sunlight



BLUE GREEN RED

Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, X1; Tungsten light, X2.)

	KODAK COLOR FILTER	WRATTEN FILTERS							KODAK POLA-SCREEN
		K2	G	X1	X2	A	B	C5	
Sunlight	1.5	2.0	2.5	5	—	4.0	7.0	5.0	2
Tungsten	1.5	1.5	2.0	4	5.0	2.0	6.0	10.0	2

NOTE: Individual lighting conditions vary considerably and the filter factors will vary accordingly. The values given, however, will serve as a guide.

**Contrast:** Correct processing yields a fixed contrast suited to projection.

**Recommended Processing:** The film must be processed by the recommended reversal procedure, for which the Developing Outfit for Kodak Direct Positive Panchromatic Film is available.

This outfit consists of chemicals for the preparation of the following solutions: 1 quart each of first developer, bleach bath, and clearing bath; 2 quarts of hardener bath, and 5 pints of redeveloper. These quantities are sufficient for processing 8 rolls of film or equivalent.

*Complete instructions are furnished with each outfit.* An outline of the time required for each step of the processing procedure follows:

SUMMARY OF PROCEDURE—All solutions at 68° F. (20° C.)

1. First developer.....	11 minutes	5. Redeveloper.....	7 minutes
2. Hardener.....	5 minutes	6. Water rinse.....	2 minutes
3. Bleach.....	3 minutes	7. Fixing bath.....	5 minutes
4. Clearing bath.....	2 minutes	8. Wash.....	20 minutes

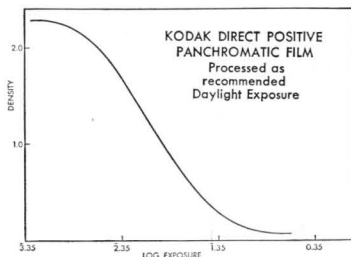
**Sensitometric Curves:** These data are for average product and average processing conditions and are sufficiently accurate for ordinary photographic work. When results of high precision are needed, the material should be calibrated under working conditions.

**Graininess:** Extremely low; reversal processing yields transparencies which show practically no grain on normal projection. The resultant transparencies have better definition and less graininess than those printed from the usual negative materials onto positive film or lantern slide plates.

**Resolving Power:** 70 lines per mm.

**Safelight:** All processing operations must be carried out in absolute darkness until the bleaching has been completed. A Wratten Series OA (yellow-green) Safelight can be used during clearing and redevelopment and fixation. The film should not be exposed to white light nor inspected before an illuminator until fixed completely, or veiled highlights may result.

**Rolls Available:** DP135 (36 exposures, 35-mm.). DP828 (8 exposures, Bantam).



40 KODAK FILMS



# Data—KODAK POSITIVE SAFETY FILM AND KODAK HIGH CONTRAST POSITIVE SAFETY FILM

**General Properties:** Low-speed, positive type emulsions useful for making positive transparencies from miniature negatives. Not recommended for general camera work, but can be used for copying where neither the panchromatic qualities nor the extreme fine-grain characteristics of Kodak Micro-File Film are needed.

Positive Safety Film is especially recommended for making positive transparencies from continuous-tone negatives.

High Contrast Positive Safety Film is intended for positive transparencies from miniature line copy negatives or for copying black-and-white line originals.

**Color Sensitivity:** Blue sensitive only.



Spectrogram to Tungsten Light

**Meter Settings and Development Recommendations for Copying:** The following meter settings are based on normal position of calculator being set at the reading obtained from a white surface in the copying position.

For copying continuous-tone originals, use Kodak Positive Safety Film with a meter setting of 2.5, and give ten times the indicated exposure. Develop 4 minutes in Kodak D-76 at 68°F. with continuous agitation.

For copying line originals, use Kodak High Contrast Positive Safety Film with a Weston meter setting of 1.5 or a General Electric meter setting of 2.5. Develop 4 minutes in Kodak D-11 at 68°F. with continuous agitation.

**Exposure for Copying:** With two No. 1 Photoflood Lamps (new lamps, rated voltage; slight increase needed after about 1 hour in use) in Copying Lights for Kodak Precision Enlarger or in Kodak Handy Reflectors at 40 in.: Positive Safety Film (for continuous-tone originals), 6 secs. at  $f/11$  (effective aperture); High Contrast Positive Safety Film (for line originals), 3 secs. at  $f/22$  (effective aperture).

**Relative Printing Speed:**

Positive Safety—about 10x speed of Kodabromide Paper No. 2.

High Contrast Positive Safety—about 5x speed of Kodabromide Paper No. 4.

**Development Recommendations:** These development times produce contrasts corresponding approximately to the contrasts of printing and enlarging papers as indicated.

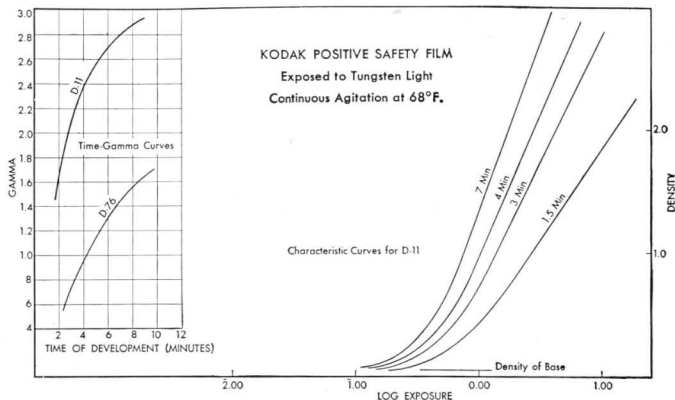
EQUIVALENT CONTRAST OF PAPER			FILM	DEVELOPMENT TIME D-11, CONTINUOUS AGITATION, 68°F. (20°C.)	
<i>Azo or Velox</i>	<i>Kodabromide</i>			<i>Film Printed by Contact</i>	<i>Film Printed by Projection</i>
Contact Printed	Contact Printed	Pro- jection Printed			
0	1	—	Kodak Positive Safety	1 ½ minutes*	—
1	2	1		3 minutes**	1 ½ minutes*
2	3	2		4 minutes	3 minutes**
3	4	3		7 minutes	4 minutes
4	—	4		—	7 minutes
4	—	4	High Contrast Positive Safety	2 minutes	—
5	—	—		4 minutes	2 minutes

\*Similar contrast obtained in Kodak D-72 (1:2) in 1 minute.

\*\*Similar contrast obtained in Kodak D-72 (1:2) in 2 ½ minutes.

**Examples:** If a negative is known to yield good prints by contact on Azo or Velox No. 1, then a slide properly exposed by contact on Kodak Positive Safety Film should develop to the proper contrast in approximately 3 minutes (Column 5). If the film is printed by projection, development time should be reduced to 1 ½ minutes (Column 6). Likewise, a negative should produce good slides with this film and processing if it is known to yield good prints by projection on Kodabromide No. 1.

**Characteristic Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.

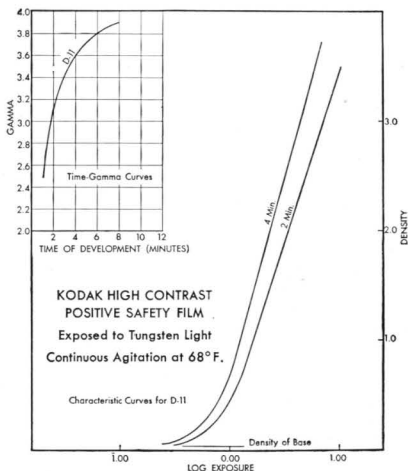


**Resolving Power:** (for 30:1 subject contrast, optimum exposure, recommended development) Positive Safety Film, 55 lines per mm.; High Contrast Positive Safety Film, 100 lines per mm.

**Fixing:** Rinse in water, fix 5 to 10 minutes in Kodak Fixing Bath F-5, wash 20 to 30 minutes, wipe under water, then wipe off droplets before drying in dust-free air.

**Safelight:** Wratten Series OA (greenish-yellow).

**Toners Suitable:** Kodak Sepia Toner, Kodak Sulfide Toner T-10 (sepia), Kodak Uranium Toner T-9 (brown to red), Kodak Iron Toner T-11 (blue), Kodak Dye Toners T-17 and T-20, Kodak Double Toner T-18.



**Forms Available:** 35-mm., perforated—No. 401 (50 ft.), No. 402 (100 ft.), and No. 403 (200 ft.) bulk rolls. Kodak Positive Safety Film is also supplied in No. PU401 (unperforated, 50 ft.) rolls for positives from Bantam negatives, and in regular sheet-film sizes.

## Data—KODAK MICRO-FILE FILM (35-MM.)

**General Properties:** An extremely fine-grained, slow, panchromatic emulsion on safety base, especially designed for making greatly reduced copies of newspapers, manuscripts, line drawings, letters, etc. It should be used in all cases where the copy negatives represent more than a tenfold reduction in size.

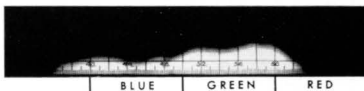
**Meter Settings For Copying Line Originals:** Based on normal position of calculator being set at the reading obtained from a white surface in the copying position.

LINE, WHITE-CARD METER SETTINGS	WESTON	G. E.
TUNGSTEN	2.5	4

**Exposure:** With two No. 1 Photoflood Lamps (new lamps, rated voltage; slight increase needed after about 1 hour in use) in Copying Lights for Kodak Precision Enlarger or in Kodak Handy Reflectors at 40 in.: 1/5 sec. at  $f/6.3$  (effective aperture); as the contrast is high, the exposure will be critical. Trial exposures are consequently advisable.

**Color Sensitivity:** Panchromatic.

Spectrogram to Tungsten Light



**Filter Factors:**

	K2	G	A
TUNGSTEN	1.5	2	6

For copying badly aged manuscripts or books with yellowed paper, the Wratten K2 or G Filter may be of aid in securing adequate contrast. For copying blueprints, the Wratten A Filter is recommended.

**Contrast:** Recommended development in Kodak D-11 gives a gamma of approximately 4.0.

**Recommended Development:**

DEVELOPER	USE	CONTINUOUS AGITATION 68° F. (20°C.)	INTERMITTENT AGITATION* 68° F. (20°C.)
Kodak D-11	High contrast; line copying	4 minutes	5 minutes

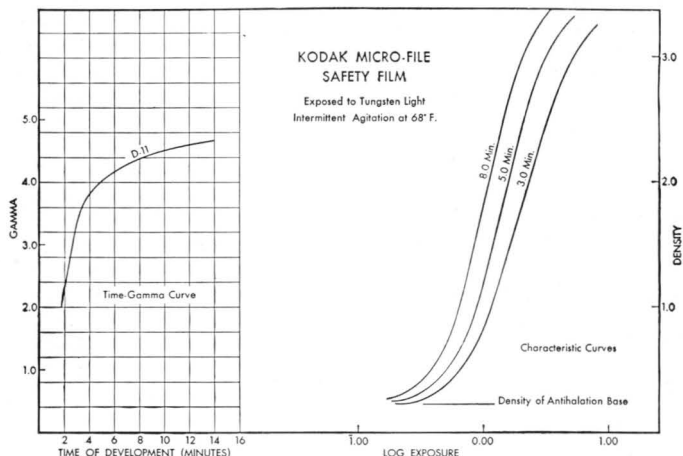
\*Agitation at one-minute intervals during development.

Kodak Developer D-19 also gives good results.

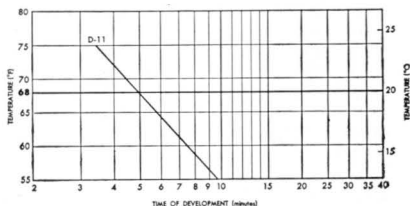
**Graininess:** Extremely low. Permits very great enlargement without visible grain.

**Resolving Power:** 160 lines per mm. This figure for resolving power is based on optimum exposure, subject contrast of 30 to 1, and recommended development.

**Sensitometric Curves:** These data are for average product and average processing conditions and are sufficiently accurate for all ordinary photographic work. When results of high precision are required, the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curve** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Fixing:** Rinse in water, fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder with Hardener.

**Washing and Drying:** Wash 30 minutes in running water, remove to another wash tray or tank and swab with cotton while submerged in the water, then rinse under a faucet. Wipe carefully with a soft sponge or chamois to remove water drops from surface and dry without the use of a fan and in a location as dust free as possible.

**Safelight:** Total darkness, or Wratten Series 3.

**Rolls Available:** 35-mm.—M135 magazine (36 exposures), and bulk 35-mm. rolls as follows: No. 401 (50 ft.), No. 402 (100 ft.), and No. 403 (200 ft.).

**44 KODAK FILMS**

## Data—KODAK SUPER PANCHRO-PRESS, SPORTS TYPE SHEET FILM (*Antihalation*)

**General Properties:** A panchromatic film of extremely high speed, specifically designed for difficult sports pictures and other work where exposures must be made at fast shutter speeds with poor illumination. The high speed has been obtained without any sacrifice in good tone rendering and photographic quality.

This film has good keeping properties, but storage in a refrigerator, until the day before the package is opened, is recommended in order to maintain optimum speed. Also, it should be developed for the full recommended time, preferably with fresh developer solution. In cases where underexposure is suspected, even longer development time may be helpful.

**Film Exposure Index:** Daylight **250** Tungsten **200.**

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

	K1	K2	G	F	A	B	C4	C5	X1
Sunlight	1.5	2	3	15	7	7	12	5	—
Tungsten	1.5	1.5	2	8	3.5	7	24	10	3

**Photoflash Outdoor Guide Exposure Numbers** for outdoors at night or large dark interiors: Divide by the distance in feet from lamp to subject to find *f*-number. For average subjects in average room with light-colored walls and ceilings, use double these guide exposure numbers.

PHOTOFLASH LAMP	SM	No. 5	No. 11	No. 22	No. 6	No. 31
Kodak Senior and similar synchronizers —1/100 second	—	180	200	300	—	—
Kodak Junior Synchronizer—1/50 second	110	210	—	—	—	—
Focal-plane shutter synchronizers —1/100 second	—	—	—	—	100	125

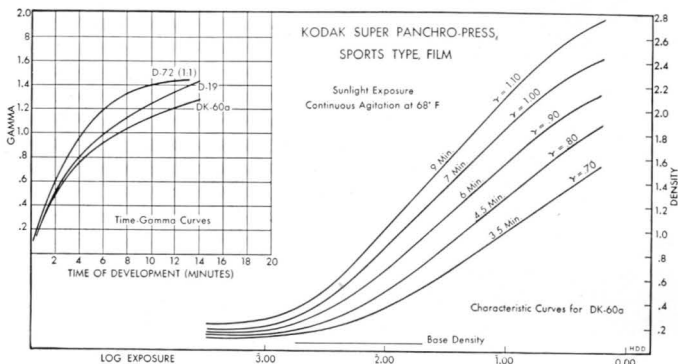
**Kodatron Guide Exposure Number:** 440—for rooms with light-colored walls and ceilings, with the Kodatron Speedlamp (studio model) near the camera axis.

**Recommended Development:**

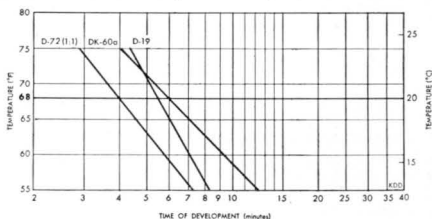
KODAK DEVELOPER	CONTINUOUS AGITATION (TRAY) 68°F. (20°C.)	INTERMITTENT AGITATION* (TANK) 68°F. (20°C.)
DK-60a D-19 Dektol (1:1) or D-72 (1:1)	6 minutes 5½ minutes 4 minutes	8 minutes 7 minutes 5½ minutes
*Agitation at one-minute intervals during development.		

**Contrast:** Recommended development gives gamma values of about 0.90 to 0.95.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68°F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68°F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70°F.*



**Graininess:** Allows moderate enlargement without objectionable grain.

**Resolving Power:** 35 lines per mm. This figure is based on optimum exposure, subject contrast of 30 to 1, and recommended development in Kodak D-19.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath, such as Kodak F-5; wash 20 to 30 minutes in running water. The fixing time can be shortened appreciably by using Kodak Fixing Bath F-7 or Kodak Rapid Fixer.

**Safelight:** Total darkness preferred. The Wratten Safelight Series 3, with 10-watt bulb in an indirect-type safelight lamp, at not less than 3 feet, can be used for a few seconds after development is half completed.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**46 KODAK FILMS**

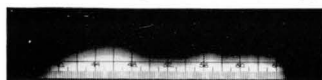
# Data—KODAK TRI-X PANCHROMATIC SHEET FILM (*Antihalation*)

**General Properties:** An extremely fast, long-scale film with excellent quality and moderate contrast, particularly suited for commercial studio work with models or other subjects requiring short exposures. Tri-X Panchromatic Film gives brilliant rendering of both highlights and shadows, even with subjects of pronounced brightness range. It is an ideal material for making color-separation negatives. The Tri-X emulsion has a fine matte surface which permits spotting and retouching to be done easily with a pencil.

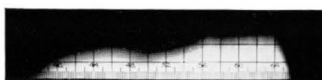
**Film Exposure Index:** Daylight **200** Tungsten **160**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type C.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, X1; Tungsten, X2.)

	K1	K2	K3	G	A	B	C5	F	N	C4	X1	X2	POLA-SCREEN	
													E. TYPE I	KODAK
Sunlight	1.5	2	2	2.5	6	9	5	12	15	12	5	—	4	2
Tungsten	1.5	1.5	1.5	2	3	9	10	6	15	24	4	5	3	2

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	320	360	540	—
Kodak Junior Synchronizer—1/50 sec.	200	380	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	220

\*Divide by distance in feet from lamp to subject to find *f*-number.

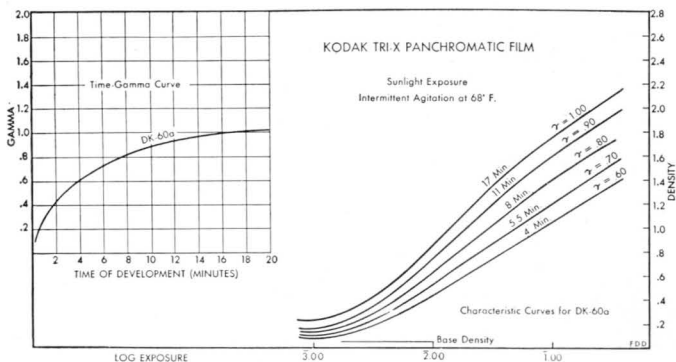
**Contrast:** Recommended development in Kodak DK-60a gives a gamma of approximately 0.7. Maximum practical gamma with Kodak DK-60a, about 1.0.

**Recommended Development:**

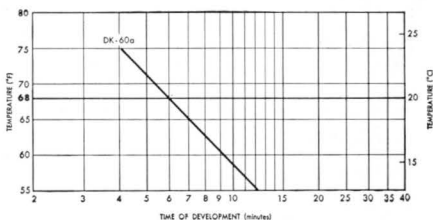
DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
Kodak DK-60a	General Maximum contrast	5 minutes 9 minutes	6 minutes 12 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Allows moderate enlargement without objectionable grain.

**Resolving Power:** 40 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3 may be used with 10-watt bulb at 3 feet, for only a few seconds after development is one-half completed.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**48 KODAK FILMS**



## Data—KODAK SUPER PANCHRO-PRESS, TYPE B, SHEET FILM (*Antihalation*)

**General Properties:** A panchromatic film combining high speed, fine grain, and good highlight separation. The color balance produces good rendering of flesh tones when this film is used with Photoflash lamps under normal circumstances in press photography and also makes this film suitable for portraits and illustrative photographs of living models. When used with fluorescent lighting equipment, Super Panchro-Press, Type B, produces excellent portrait negatives.

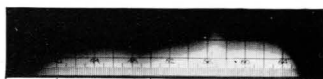
**Film Exposure Index:** Daylight **125** Tungsten **100**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

	K1	K2	K3	G	A	B	C5	X1
Sunlight	1.5	2	2	3	7	7	5	—
Tungsten	1.5	1.5	1.5	2	3.5	7	10	3

**Photoflash Outdoor Guide Exposure Numbers** for outdoors at night or large dark interiors: Divide by the distance in feet from lamp to subject to find *f*/number. For average subjects in average room with light-colored walls and ceilings, use double these guide exposure numbers.

GUIDE EXPOSURE NUMBERS	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	130	145	220	—
Kodak Junior Synchronizer—1/50 sec.	80	155	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	90

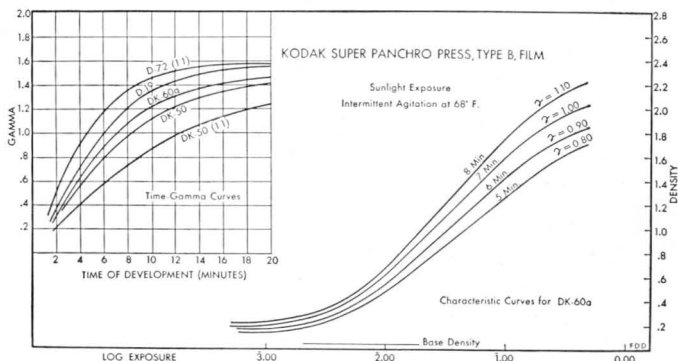
**Recommended Development:**

KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
DK-60a	Press	4½ minutes	6 minutes
D-19	Press	4 minutes	5 minutes
Dektol (1:1)	Press	3 minutes	4 minutes
D-72 (1:1)	Press	3 minutes	4 minutes
DK-50	Commercial	5½ minutes	7 minutes
DK-60a	Commercial	4½ minutes	6 minutes
DK-50	Portraiture	4 minutes	(1:1) 8 minutes

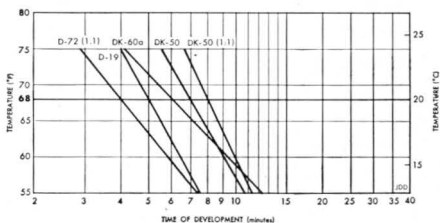
\*Agitation at one-minute intervals during development.

**Contrast:** Maximum practical gamma with Kodak D-19 is about 1.5. A wide range of contrasts can be obtained by proper choice of developer and developing time. Recommended development in Kodak DK-60a for press photography gives a gamma of about 0.9; in Kodak DK-50 or DK-60a for commercial photography, about 0.9; in Kodak DK-50 for portraiture, about .75.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves:** Each development time recommended above for intermittent agitation yields a certain contrast at 68°F. The times at other temperatures to yield the same contrast are given by the diagonal line on this chart. For a different contrast, or different agitation, find the time at 68°F., and through the corresponding point on the chart draw a new diagonal line parallel to the one for the developer in use. Read the desired time from this new line. *Best results are obtained at 65°F. to 70°F.*



**Graininess:** Moderate. Allows enlargement without objectionable grain.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3 (dark green) at 3 feet with 10-watt bulb, for only a few seconds after development is one-half completed.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**50 KODAK FILMS**

# Data—KODAK SUPER-XX

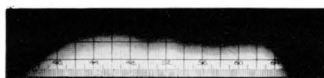
## PANCHROMATIC SHEET FILM (*Antihalation*)

**General Properties:** This film uniquely combines the advantages of a fast emulsion with pronounced fineness of grain. It possesses wide exposure and development latitude together with sufficiently fine grain to permit a considerable degree of enlargement. It is an excellent choice for photographers who wish to standardize on a single panchromatic film for general commercial and portrait use. An excellent balance between speed and fine grain is secured on this film when developed in Kodak Developer D-76.

**Film Exposure Index:** Daylight **100** Tungsten **64**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

	K1	K2	K3	G	A	B	C5	F	N	C4	X1	POLA-SCREEN	
												E. TYPE I	KODAK
Sunlight	1.5	2	2	3	6	8	5	12	10	12	4	4	2
Tungsten	1.5	1.5	1.5	2	3	8	10	6	10	24	3	3	2

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	195	220	330	—
Kodak Junior Synchronizer—1/50 sec.	125	235	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	135

\*Divide by distance in feet from lamp to subject to find *f*-number.

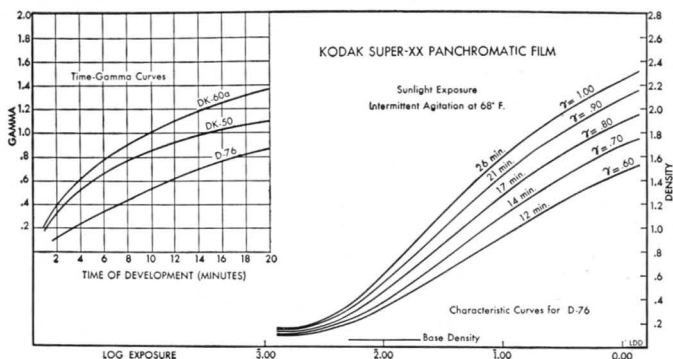
**Contrast:** Recommended development in Kodak D-76a gives gamma of about 0.85. Maximum practical gamma with DK-60a about 1.2.

**Recommended Development:**

DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
Kodak D-76	General	16 minutes	20 minutes
Kodak DK-60a	General	5½ minutes	7 minutes
Kodak DK-50	General	8 minutes	10 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*

Y-axis: TEMPERATURE (°F) (55 to 80)  
X-axis: TIME OF DEVELOPMENT (minutes) (2 to 40)

Curves shown: DK-60a, DK-50, D-76

**Graininess:** Medium. Allows considerable degree of enlargement without objectionable grain.

**Resolving Power:** 50 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3 with 10-watt bulb, at 3 feet, for only a few seconds after development is one-half completed.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**52 KODAK FILMS**

# Data—KODAK PORTRAIT PANCHROMATIC SHEET FILM (*Antihalation*)

**General Characteristics:** Recognized as a standard panchromatic film for all types of portrait work. Its color sensitivity is particularly desirable for portraiture. Even with the high red content of clear tungsten lamps, the color balance of Portrait Panchromatic film gives correct rendering of delicate color contrasts. Thus it produces portraits of pleasing modeling, a prerequisite of good photographic quality.

**Film Exposure Index:** Daylight **50** Tungsten **32**.  
These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Panchromatic, Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Sunlight, K2; Tungsten, X1.)

	K1	K2	K3	G	A	B	C5	F	N	C4	X1	POLA-SCREEN	
												E. TYPE I	KODAK
Sunlight	1.5	2	2	3	7	6	5	15	7	12	4	4	2
Tungsten	1.5	1.5	1.5	2	4	6	10	8	7	24	3	3	2

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	140	155	235	—
Kodak Junior Synchronizer—1/50 sec.	85	165	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	95

\*Divide by distance in feet from lamp to subject to find *f*-number.

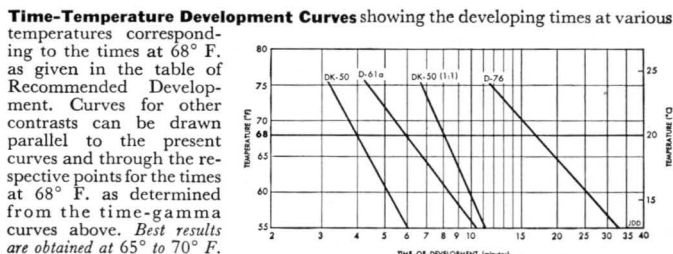
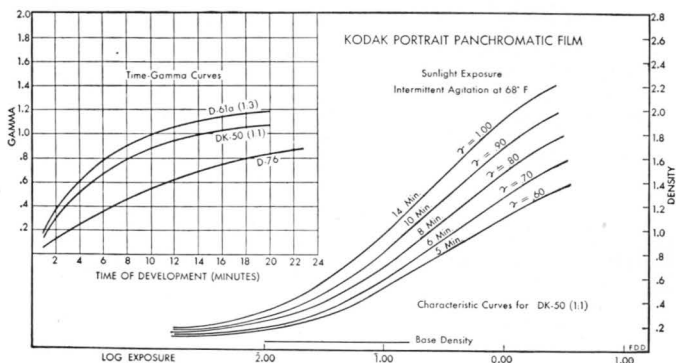
**Contrast:** Moderate. Recommended development (portrait) gives a gamma of about 0.8; more or less contrast obtained by longer or shorter development time. Maximum practical gamma with Kodak DK-50 about 1.0.

**Recommended Development:**

FORMULA	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)		INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)	
Kodak DK-50	Portraits	Undiluted	4 min.	Diluted 1:1	8 min.
Kodak D-61a	Portraits	Diluted 1:1	3 min.	Diluted 1:3	6 min.
Kodak D-76	Portraits	Undiluted	14 min.	Undiluted	17 min.

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Graininess:** Enlargements up to 10 diameters are possible without fine-grain processing.

**Resolving Power:** 50 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred, or Wratten Series 3 (dark green) at 3 feet with 10-watt bulb, only after development is one-half completed.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**54 KODAK FILMS**

## Data—KODAK PANATOMIC-X SHEET FILM (Antihalation)

**General Properties:** A very fine grain, high quality panchromatic film of moderate speed and contrast. The fineness of grain makes it particularly suited for photomural work and any other applications where a considerable degree of enlargement is required. It is suitable for outdoor or indoor photography when the highest speed is not needed, and excellent for copying continuous-tone originals. The best balance between fine grain and speed is secured from development in Kodak Developer D-76.

**Film Exposure Index:** Daylight **32** Tungsten **20**.

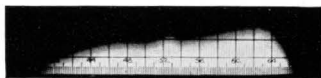
These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Continuous-Tone, White-Card Meter Setting for Copying (Tungsten)** based on normal position of calculator being set at the reading obtained from a white surface in the copying position: **5**.

**Color Sensitivity:** Panchromatic Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Daylight, K2; Tungsten, X1.)

	K1	K2	K3	G	A	B	C5	F	N	C4	X1	POLA-SCREEN	
												TYPE 1	KODAK
Sunlight	1.5	2	2	3	7	6	5	15	7	12	4	4	2
Tungsten	1.5	1.5	1.5	2	4	6	10	8	7	24	3	3	2

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	115	125	190	—
Kodak Junior Synchronizer—1/50 sec.	70	135	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	75

\*Divide by distance in feet from lamp to subject to find *f*-number.

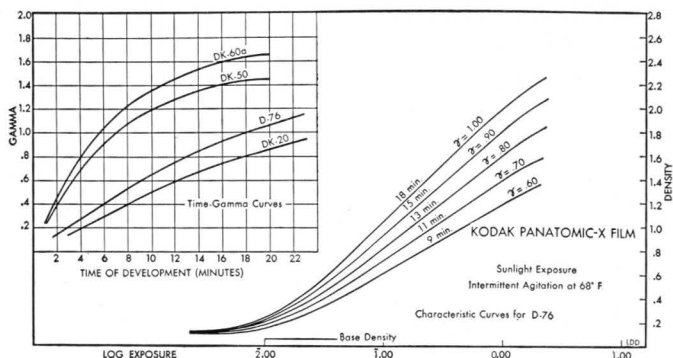
**Contrast:** Moderate. Wide range possible by varying development times in recommended developers. Recommended times give gammas about 0.9. Maximum practical gamma with DK-60a about 1.6.

### Recommended Development:

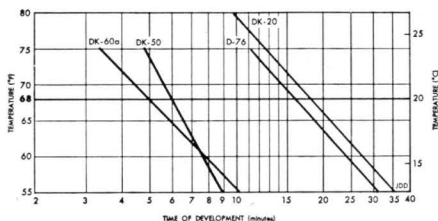
DEVELOPER	USE	CONTINUOUS AGITATION 68° F. (20° C.)	INTERMITTENT AGITATION* 68° F. (20° C.)
D-76	General	13 minutes	16 minutes
DK-60a	General	4 minutes	5 minutes
DK-50	General	5 minutes	6 minutes
Microdol	Extremely fine grain	13 minutes	16 minutes
DK-20	Extremely fine grain	14 minutes	18 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Very low. Permits great enlargement without noticeable grain even without special fine-grain processing.

**Resolving Power:** 55 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development in Kodak D-76.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather), fix 10 to 20 minutes at 68° F. (20° C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred. Wratten Series 3, dark green, at 3 feet with 10-watt bulb, for only a few seconds after development is one-half complete.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**56 KODAK FILMS**



## Data—KODAK ORTHO-X SHEET FILM (*Antihalation*)

**General Properties:** The fastest and most modern of the orthochromatic sheet films. It produces good contrast, and is often selected for portraits of men because the absence of red sensitivity gives a pronounced effect of tanned or ruddy skin texture. The speed, sensitivity, and contrast of Ortho-X render it particularly suitable for use with fluorescent "daylight" illumination.

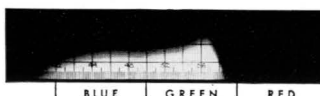
**Film Exposure Index:** Daylight **125** Tungsten **64**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Orthochromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

### Filter Factors:

	KODAK COLOR FILTER	K1	K2	K3	G	B	POLA-SCREEN	
							E. TYPE I	KODAK
Sunlight	2	2	2.5	2.5	5	8	6	2.5
Tungsten	1.5	1.5	2	2	3	4.5	4	2.5

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	195	220	330	—
Kodak Junior Synchronizer—1/50 sec.	125	235	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	135

\*Divide by distance in feet from lamp to subject to find *f*-number.

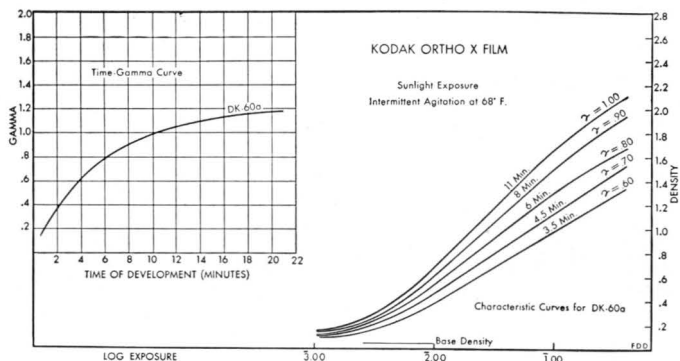
**Contrast:** Recommended development in Kodak DK-60a gives gamma of approximately 0.7. Maximum practical gamma with DK-60a, about 1.0.

### Recommended Development:

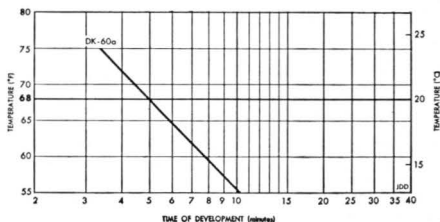
DEVELOPER	USE	CONTINUOUS AGITATION* (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
Kodak DK-60a	General Maximum contrast	4 minutes 8 minutes	5 minutes 10 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



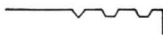
**Graininess:** Allows moderate enlargement without objectionable grain.

**Resolving Power:** 40 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 2 (deep red) may be used with a 10-watt bulb in an indirect type safelight lamp, at not less than 3 feet.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**58 KODAK FILMS**

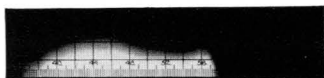
## Data—KODAK SUPER ORTHO-PRESS SHEET FILM (*Antihalation*)

**General Properties:** A high-speed, orthochromatic press film having good contrast, used extensively in both press and commercial work by photographers who prefer to develop by inspection under a red safelight rather than by the time-temperature method. Because of its orthochromatic sensitivity, Super Ortho-Press is especially suitable for Photoflash pictures of nearby people.

**Film Exposure Index:** Daylight **100** Tungsten **50**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Orthochromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

### Filter Factors:

	K1	K2	K3	G	B	C5	POLA-SCREEN	
							E. TYPE I	KODAK
Sunlight	2	2.5	2.5	5	8	3	6	2.5
Tungsten	1.5	2	2	3	4.5	3.5	4	2.5

**Photoflash Outdoor Guide Exposure Numbers** for outdoors at night or large dark interiors: Divide by the distance in feet from lamp to subject to find *f*/number. For average subjects in average room with light-colored walls and ceilings, use double these guide exposure numbers.

GUIDE EXPOSURE NUMBERS	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	90	100	150	—
Kodak Junior Synchronizer—1/50 sec.	55	105	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	60

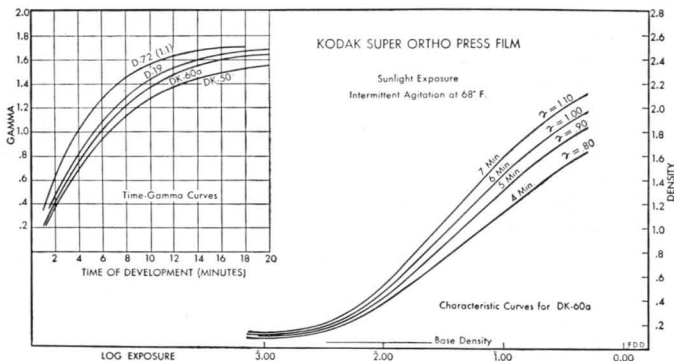
### Recommended Development:

KODAK DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
DK-60a	Press	4½ minutes	6 minutes
D-19	Press	4 minutes	5 minutes
Dektol (1:1)	Press	3 minutes	4 minutes
D-72 (1:1)	Press	3 minutes	4 minutes
DK-50	Commercial	5 minutes	6 minutes
DK-60a	Commercial	4 minutes	5 minutes

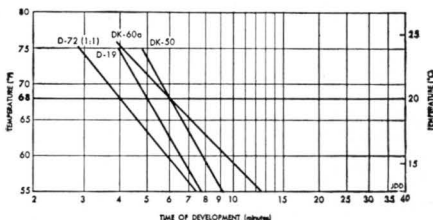
\*Agitation at one-minute intervals during development.

**Contrast:** Maximum practical gamma with Kodak D-19 about 1.6. A wide range of contrasts can be obtained by a choice of developer and development time. Recommended development for press photography gives a gamma of about 1.0; for commercial photography, about 0.9.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Moderate. Allows enlargements without objectionable grain.

**Resolving Power:** 45 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 2 (deep red).

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**60 KODAK FILMS**

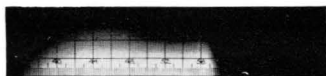
# Data—KODAK SUPER SPEED ORTHO PORTRAIT SHEET FILM (*Antihalation*)

**General Properties:** A popular, fast, ortho material with a long scale of gradation which provides for tonal separation even in extreme highlights and deep shadows. Super Speed Ortho Portrait can be used effectively with all types of lighting and this, together with its wide latitude in both exposure and development, renders it adaptable to a wide range of studio conditions. It is moderately fast in daylight, and has fair speed in artificial light.

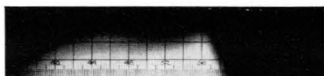
**Film Exposure Index:** Daylight **50** Tungsten **25**.

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

**Color Sensitivity:** Orthochromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

## Filter Factors:

	K1	K2	K3	G	B	C5	POLA-SCREEN	
							E. TYPE I	KODAK
Sunlight	2	2.5	2.5	5	8	3	6	2.5
Tungsten	1.5	2	2	3	4.5	3.5	4	2.5

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings, or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and Similar Synchronizers—1/100 sec.	—	130	145	220	—
Kodak Junior Synchronizer—1/50 sec.	80	155	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	90

\*Divide by distance in feet from lamp to subject to find *f*-number.

**Contrast:** Medium. Recommended development gives a gamma of about 0.75, suitable for portraiture. More or less contrast obtained by longer or shorter development time. Maximum practical gamma with Kodak DK-50 about 0.9.

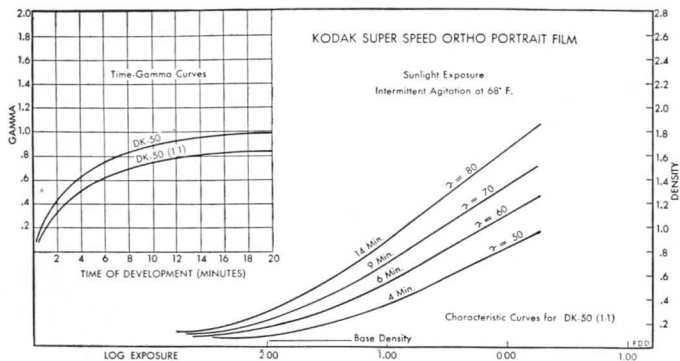
## Recommended Development:

DEVELOPER	USE	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)		INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)	
Kodak DK-50	Portrait Negatives	Undiluted	5 min.	Diluted 1:1	10 min.
Kodak DK-60a	Portrait Negatives	Undiluted	4 min.	Diluted 1:1	8 min.

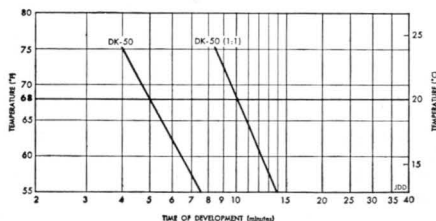
\*Agitation at one-minute intervals during development.

Kodak Developers D-7 and D-61a also give good results.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems, the material can be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Enlargements up to 10 diameters are possible without fine-grain processing.

**Resolving Power:** 45 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 2 (deep red).

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

**62 KODAK FILMS**

## Data—KODAK INFRARED SHEET FILM

**General Properties:** Kodak Infrared Sheet Film permits the use of an infrared material in cameras taking sheet film. Kodak Infrared Sheet Film has moderately high contrast, and by suitable development can be used for landscape, commercial, medical, and documentary photography, and for certain types of scientific photography and photomicrography.

**Film Exposure Index:** Tungsten 8.

This value applies for exposure through the Wratten A Filter (No. 25). It is suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended.

No settings are given for daylight since the ratio of infrared to visible radiation in daylight varies considerably, and meters respond principally to visible light. For tungsten light, this ratio is sufficiently constant to warrant use of a meter.

**Color Sensitivity:** Blue-violet and infrared.



**Filters:** To obtain infrared effect a filter must be used. The Wratten A Filter (No. 25), is recommended. Other Wratten Filters can also be used, Nos. 29 or 70, which require the same exposure as the No. 25; Nos. 88, 89, or 89a, which require about 1.5 times the exposure; and the Nos. 87 or 88a, which require double the exposure.

**Daylight Exposures:** Open Landscapes, Summer Sunlight.

<i>Exposed Through Wratten A Filter Subject in Bright Sunlight</i>		<i>Without Filter, for Ordinary (Blue Sensitive) Rendering in Bright Sunlight</i>
DISTANT SCENES	NEARBY SCENES	DISTANT SCENES
1/25 at f/8	1 second at f/22 or 1/10 at f/6.3	1/50 at f/16

**Photoflood Exposures:** Through Wratten A (No. 25), or F (No. 29).

DISTANCE, LAMPS- TO-SUBJECT	4 No. 1 PHOTOFLOODS IN KODAFLECTORS*		2 No. 22 PHOTOFLASH LAMPS IN KODAFLECTORS*
	Aperture	Time	Aperture
3 feet	f/16	½ sec.	f/32
5 feet	f/16	1 sec.	f/22

\*If the Kodak Handy Reflectors are used, give double the exposure indicated above.

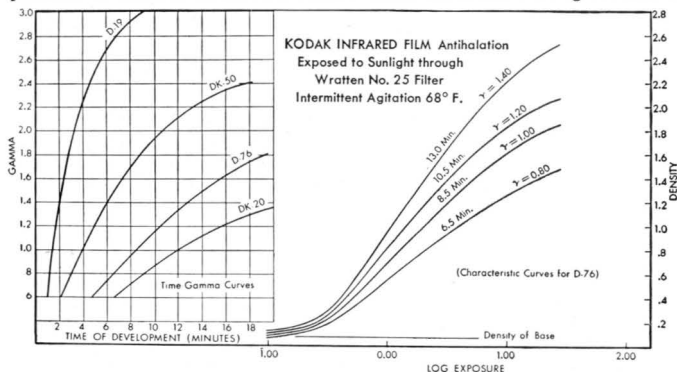
In the case of unusual subject matter or uncertain light conditions, it is advisable to make a series of exposures. First, give the exposure corresponding to the best estimate. Then, give four times (two stops) more, and last, give four times less exposure than the first. One of these usually will be satisfactory.

**Contrast:** Recommended development in Kodak D-76 gives gamma of approximately 0.9; maximum practical gamma in Kodak D-19, approximately 3.0.

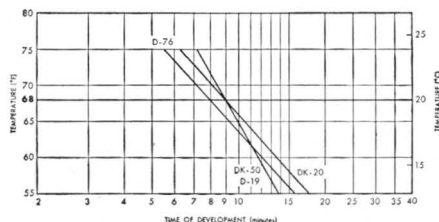
Recommended Development:		CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
KODAK DEVELOPER	USE		
D-76	General	6 minutes	8 minutes
Microdol	Fine grain	7 minutes	9 minutes
DK-20	Fine grain	7 minutes	9 minutes
DK-50	High contrast	7 minutes	9 minutes
D-19	Maximum contrast	7 minutes	9 minutes

\*Agitation at one-minute intervals during development.

**Sensitometric Curves:** These curves apply for exposure to sunlight through the Wratten A (No. 25) Filter, and for development in fresh developer at 68° F. with intermittent agitation. These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Fixing:** Rinse in water, Kodak Stop Bath SB-1a, or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68° F. (20° C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness, or Wratten Series 7 (Infrared) Safelight.

**Notching Code:**



**Sizes Available:** All regularly listed sheet film sizes.

**64 KODAK FILMS**



## Data—KODAK COMMERCIAL, COMMERCIAL MATTE, AND COMMERCIAL ORTHO FILMS (*Antihalation*)

**General Properties:** Emulsions of medium speed and fine grain capable of giving a fairly high degree of contrast, especially suitable for copying continuous-tone subjects and for general commercial work.

**Commercial** is useful for copying black-and-white continuous-tone originals, such as photographs. It is blue sensitive only.

**Commercial Matte** is similar to Commercial but has a matte emulsion and a matte back to permit pencil retouching on either or both sides without retouching varnish.

**Commercial Ortho** is recommended for copying many types of colored, continuous-tone originals, for photographing light-colored furniture, and for other commercial work which does not require a red-sensitive film.

**Film Exposure Index:**

Commercial	Daylight	25	Tungsten	6
Commercial Ortho	Daylight	32	Tungsten	10

These values are suitable for use with Weston and General Electric Exposure Meters and supersede meter settings previously recommended. When it is desired to reduce the exposure to a minimum, these values can be doubled with little danger of serious underexposure.

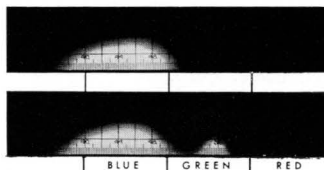
**Meter Settings for Copying Continuous-Tone Originals:** Based on normal position of calculator being set at the reading from a white surface in the copying position.

Continuous-Tone, White-Card Meter Settings	DAYLIGHT	TUNGSTEN
Commercial	6	1.5
Commercial Ortho	8	2.5

### Color Sensitivity:

Commercial  
Blue sensitive only

Commercial Ortho  
Orthochromatic



Spectograms to Tungsten Light

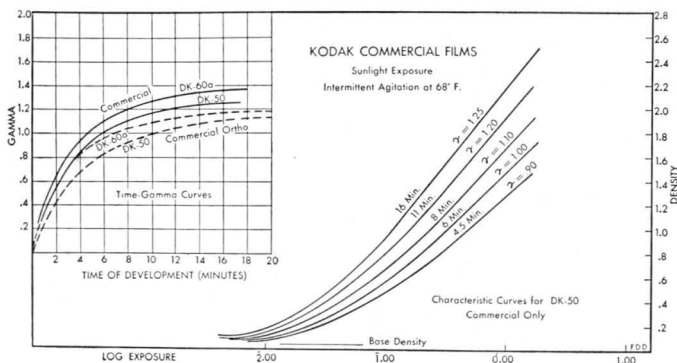
**Contrast:** A range of contrasts is available by proper choice of developer and development time. Maximum practical gamma with Kodak DK-50, about 1.2.

### Recommended Development:

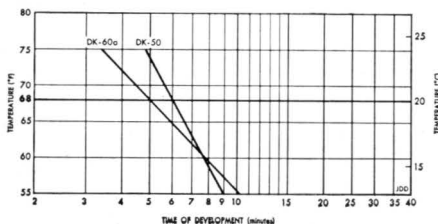
DEVELOPER	FILM	CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
Kodak DK-50	Commercial	5 minutes	6 minutes
Kodak DK-50	Commercial Ortho	7 minutes	9 minutes
Kodak DK-60a	Commercial	4 minutes	5 minutes
Kodak DK-60a	Commercial Ortho	5 minutes	6 minutes

\*Agitation at one-minute intervals during development.  
Kodak D-61a also gives good results.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Moderate.

**Resolving Power:** 50 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development in Kodak DK-50.

**Fixing:** Rinse thoroughly in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68° F. (20° C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 1 (red).

**Notching Code:**



Commercial



Commercial Matte



Commercial Ortho

**Sizes Available:** All regularly listed sheet-film sizes.

**66 KODAK FILMS**

## Data—KODAK CONTRAST PROCESS ORTHO and CONTRAST PROCESS PANCHROMATIC FILMS (*Antihalation*)

**General Properties:** These films have extremely high contrast and fine grain. They are intended for making line copies. The short toe region (see sensitometric curves) allows particularly sharp separation of the light and dark tones and thus produces extremely clear lines. Compared with the former Eastman Process Panchromatic Film, the new materials are faster, more contrasty, and have less graininess.

**Contrast Process Ortho** is useful for copying both black-and-white originals and certain types of colored copy, such as telegrams, maps, drawings, where yellow-green or blue-green hues predominate. It can be used with the filters listed below and can be developed by inspection under a suitable safelight.

**Contrast Process Panchromatic** is sensitive to all colors and is recommended especially for copying colored originals, such as maps, drawings, or documents which have been drawn or printed with colored inks, and for photographing faded originals of low contrast. All filters can be used with this film.

**Meter Settings for Copying Line Originals:** Based on normal position of calculator being set at the reading from a white surface in the copying position.

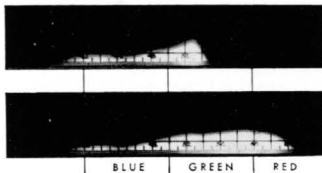
Line, White-Card Meter Settings	WESTON		G. E.	
	DAYLIGHT	TUNGSTEN	DAYLIGHT	TUNGSTEN
Contrast Process Ortho	16	8	24	12
Contrast Process Panchromatic	16	10	24	16

### Color Sensitivity:

*Spectrograms to Tungsten Light*

Contrast Process Ortho  
Orthochromatic

Contrast Process Panchromatic  
Panchromatic, Type B



Filter Factors:		K1	K2	K3	G	F	A	B	C5	POLA-SCREEN	
										E. TYPE 1	KODAK
Contrast Process Ortho	*White Flame Arc	2	3	4	6	—	—	—	—	6	2.5
	Photoflood	1.5	2	2.5	3.5	—	—	—	—	4	2.5
Contrast Process Panchromatic	*White Flame Arc	—	2	3	5	30	14	11	6	4	2
	Photoflood	—	1.5	2	2.5	9	4.5	6	15	3	2

\*With the anode in the lower position.

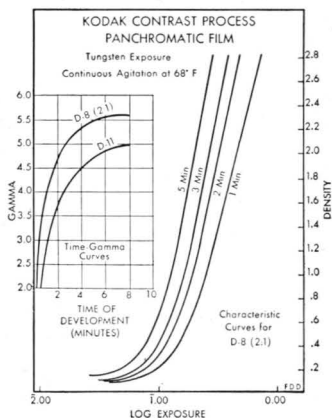
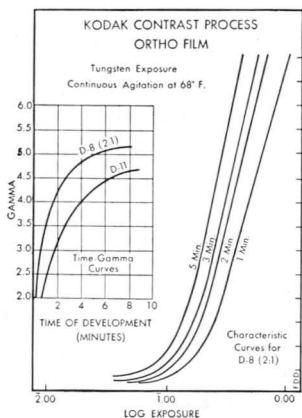
**Contrast:** Extremely high. Recommended development in Kodak D-11 gives a gamma of about 4.0, Kodak D-8 yields slightly higher contrast. The short toe of the curve helps to increase the effective contrast.

Recommended Development:		CONTINUOUS AGITATION (TRAY) 68° F. (20° C.)	INTERMITTENT AGITATION* (TANK) 68° F. (20° C.)
DEVELOPER	USE		
Kodak D-8 (2:1)**	Maximum Contrast and Density	2 min.	—
Kodak D-11	High Contrast	4 min.	5 minutes

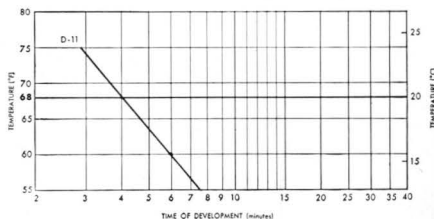
\*Agitation at one-minute intervals during development.

\*\*2 parts stock solution, 1 part water.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Resolving Power:** Contrast Process Ortho—125 lines per mm; Contrast Process Pan—80 lines per mm. These figures for resolving power are based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse for about 20 seconds in Kodak Stop Bath SB-1a; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash for 30 minutes in running water.

**Safelights:** Contrast Process Ortho, Wratten Series 1 (red); Contrast Process Panchromatic, total darkness preferred, but Wratten Series 3 (dark green) may be used.

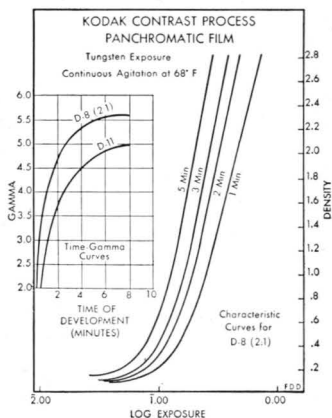
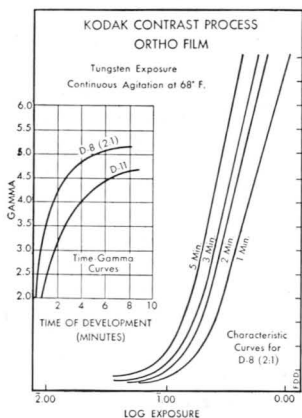
**Notching Code:**



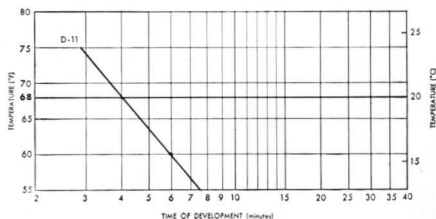
**Sizes Available:** All regularly listed sheet-film sizes.

**68 KODAK FILMS**

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F. as given in the table of Recommended Development. Curves for other contrasts can be drawn parallel to the present curves and through the respective points for the times at 68° F. as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*

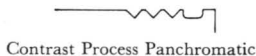


**Resolving Power:** Contrast Process Ortho—125 lines per mm; Contrast Process Pan—80 lines per mm. These figures for resolving power are based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse for about 20 seconds in Kodak Stop Bath SB-1a; fix 10 to 20 minutes at 68°F. (20°C.) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash for 30 minutes in running water.

**Safelights:** Contrast Process Ortho, Wratten Series 1 (red); Contrast Process Panchromatic, total darkness preferred, but Wratten Series 3 (dark green) may be used.

**Notching Code:**

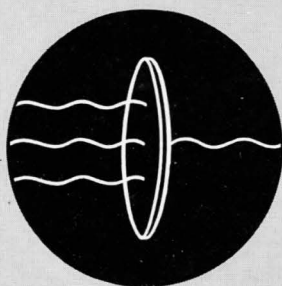


**Sizes Available:** All regularly listed sheet-film sizes.

**68 KODAK FILMS**



**FILTERS**



# FILTERS AND POLA-SCREENS

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Second 1946 Printing



Types of  
Filters

Sky Brightness  
Control

Filters for  
Outdoor Subjects

Contrast Filters  
in Commercial  
Photography

Filter  
Factors

Kodak  
Combination Lens  
Attachments

K1

K2 • K3  
Aero 1 • Aero 2

CK-3 • X1

X2 • G

A • F

B • C5

Tricolor

Pola-Screens

DATA SHEETS



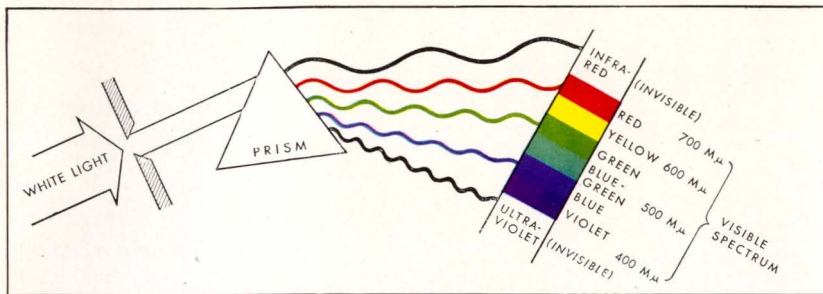


FIGURE 1.

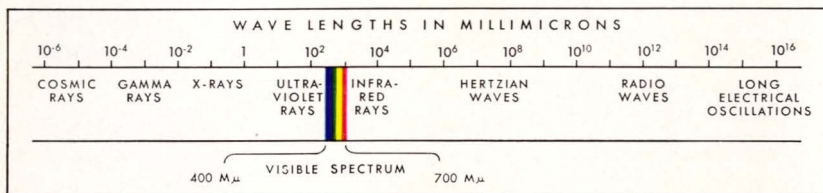


FIGURE 2.

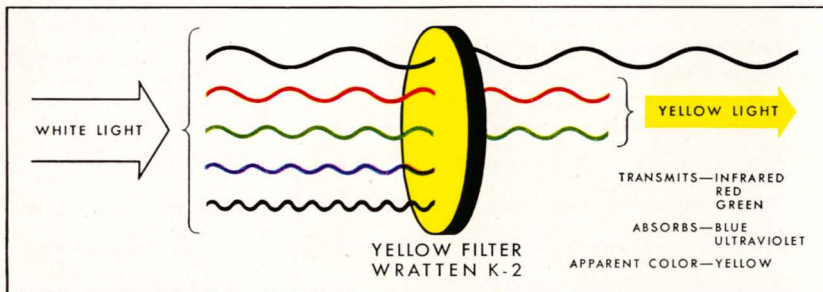


FIGURE 3.

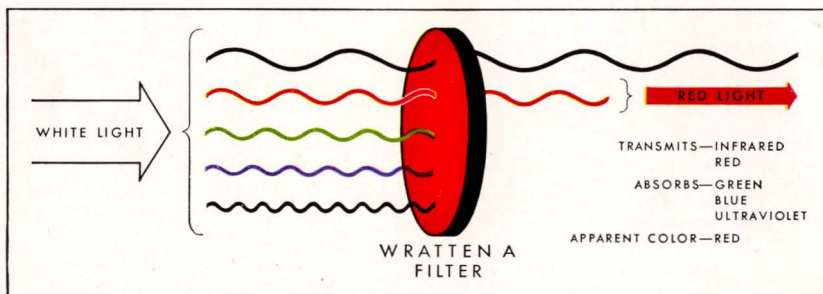


FIGURE 4.

# FILTERS

## AND POLA-SCREENS

SKILLED photographers strive to produce record photographs that are technically correct, and pictorial photographs of artistic merit. Important in achieving both aims in black-and-white photography is the ability to exercise control over the tone reproduction of colored subjects. Such control is achieved through the proper use of filters in conjunction with Kodak Films.

More than 100 different Wratten Light Filters are available; all are manufactured with extreme care. Their prestige in the photographic field is the result of constant improvement in the determination and control of filter characteristics in the Kodak Research Laboratories—improvement made possible by the related knowledge of films and film sensitizing. These filters, made from organic dyes of great purity and brightness, are prepared in gelatin sheets of a prescribed thickness and are held to rigid standards by scientific control. In the manufacture of a wide range of filters with dyed gelatin, it is possible to meet high standards of reproducibility.

Gelatin film filters are used largely for experimental work; they are delicate and must be handled with care. For continued use they are supplied cemented between glass sheets—glass of the same optical quality as that used in lenses. The “B” glass is satisfactory for average photographic purposes, while “A” glass, in polished optical flats, is of the highest accuracy for scientific work and for use with lenses of long focal length.

Kodak Pola-Screens are valuable photographic tools in that they afford extensive control over reflections, and over the rendering of blue skies in color photography.

The text of this booklet explains and illustrates the theory and use of filters with black-and-white negative materials. Data Sheets for selected Wratten Filters begin on page 25. Information about Pola-Screens appears on pages 38 to 40.

## LIGHT AND COLOR

WHITE light, sunlight for instance, is a composite of all the colors of the visible spectrum. When a beam of white light is passed through a prism (Figure 1), it is split up into its component parts—a band having all the colors of the rainbow. This is the visible spectrum and is but a tiny part of the electromagnetic spectrum (Figure 2).

Light rays, like radio waves, gamma rays, infrared and ultraviolet rays, x-rays, cosmic rays, and others, are forms of electromagnetic radiation—wave motions in the ether—differing from one another only in their wave length and frequency. Those rays between 400 and 700 millimicrons ( $m\mu$ )\* in length are visible and are what we know as light.

Color is a matter of wave length, those rays from 400 to 500  $m\mu$  in length giving the sensation of blue, 500-600  $m\mu$  green, and 600-700  $m\mu$  red. When the eye receives all these waves at once, and in the proper proportions, their combined effect produces the sensation known as white.

### The Action of Light Filters

The action of a filter is to stop light of certain colors. That is, rays of some colors are allowed to pass through freely, while others are partially or wholly absorbed. This is the fundamental concept of a filter, and should be kept in mind whenever a filter is to be used.

Because a filter selectively absorbs certain rays, it necessarily appears colored. A red book appears red because it *reflects* red light and *absorbs* light of other colors. A red filter appears red because it absorbs green and blue light and transmits red light freely (see Figure 4). A filter which absorbs red and green light appears blue. Looking through such a filter, red and green objects appear dark, while blue objects appear light. A filter which absorbs blue and red is green; one which absorbs only blue appears yellow because it transmits green and red, and these affect the eye as yellow. The popular Wratten K2 Filter reduces the amount of light in the blue region of the spectrum without appreciably reducing light of other colors, and appears yellow (Figure 3). However, all yellow transparent substances are not suitable as filters, because some transmit freely the ultraviolet and yet appear identical to others which absorb it completely. Such materials are valueless for photography.

Into Wratten Filters go the most efficient organic dyes that can be

---

\*The normal units of measurement are so big that it would be cumbersome to express wave lengths of light by them. It is, therefore, customary to use the millimicron ( $m\mu$ ) which is one millionth of a millimeter or the Ångström unit (Å) which is one ten-millionth of a millimeter.

found—efficient in that their transmission is as high as possible in the desired spectral region, and their absorption adequate for the colors they are intended to stop. Figure 5 shows a typical filter absorption curve, which demonstrates graphically the proportion of light absorbed at any wave length. Absorption curves and wedge spectrograms are given in the filter Data Sheets, starting on page 25. The spectrograms show the color sensitivity which will be obtained by using each filter with a Kodak panchromatic material.

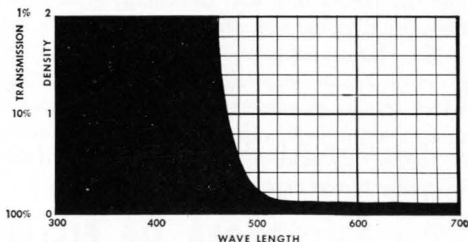


Figure 5—Typical Filter Absorption Curve. (K2 Filter)

### Filter Factors

As every filter absorbs a certain proportion of light, it quite naturally reduces the amount of light reaching the film. An increase in exposure will therefore be required to compensate for the light absorbed by the filter. The number by which the exposure must be multiplied for a given filter with a particular film is called the “multiplying factor” or “filter factor” of that filter. This is dependent not only on the color of the filter itself, but also on the nature of the light source and the sensitivity of the negative material which is to be used. An explanation of the classes and types of color sensitivity into which Kodak negative materials are grouped may be found in the Data Book, *Kodak Films*, and in the Films section of the Kodak Reference Handbook. A table of these filter factors for the Wratten Filters most commonly used appears on page 18.

Since there is a difference in the color values of sunlight and tungsten light, the filter factor for the same film and filter will be different for these two light sources. Tungsten lacks the large proportion of blue and violet light characteristic of sunlight and is therefore proportionately stronger in the red. The resulting difference in filter factors is illustrated by the factors for the A filter with Type C panchromatic materials: 4 in sunlight and 2 in tungsten. This occurs because the blue portion of the spectrum absorbed by the A filter comprises about  $\frac{3}{4}$  of the predominantly blue sunlight, while it comprises only  $\frac{1}{2}$  of the predominantly red tungsten light.

In ordinary picture taking, a filter factor can be applied either to

the time of exposure or to the size of the lens opening. For example, if the filter factor is 2 and the normal exposure without a filter is  $1/50$  second at  $f/11$ , it will be necessary to give either  $1/25$  second at  $f/11$  or  $1/50$  second at  $f/8$ . The *Kodak Outdoor Filter Guide*, obtainable at Kodak dealers, provides filter recommendations for typical outdoor subjects and, by means of a dial calculator, gives a direct indication of the exposure required according to the filter selected.

Filter factors supplied for use with Kodak products are sufficiently accurate for all ordinary purposes. However, in certain applications which require precise exposure, considerations may be present which affect the filter factor. In such instances, the recommended factor should be treated as a guide for the determination of the appropriate exposure by means of test exposures.

## TYPES OF FILTERS

COLOR FILTERS for black-and-white photography are designed for several different purposes and may be classified as: (1) *Correction* or “*orthochromatic*” filters which are used to alter the response of the film so that all colors are recorded at the brightness values seen by the eye. (The term “orthochromatic” used here means true color rendering and should not be confused with “orthochromatic” film which is sensitive to blue and green but not red.) (2) *Contrast filters* which distort the brightness values so that two colors having about the same brightness to the eye will have decidedly different brightnesses in the picture. (3) *Haze filters* which reduce or eliminate the effects of aerial haze. (4) *Tricolor filters* for making tricolor-separation negatives in color printing work. (5) *Neutral density filters* for reducing exposure.

### Correction Filters

While panchromatic films respond to all the colors which the eye can see, they will not of themselves reproduce the tones of blue, green, and red objects in the same relative values as the eye sees them. For instance, blue and violet normally appear darker to the eye than green, yet a film is very sensitive to these colors and will record them as lighter than green. By the proper use of filters, however, the response of a film can be changed to reproduce colors in the relative brightnesses that the eye sees. The excess ultraviolet and blue-violet sensitivity common to every emulsion requires some absorption of such rays, while the added red sensitivity of some panchromatic materials demands some absorption of red light as well. Filters reducing the amount of light in the blue region of the spectrum without appreciably reducing light of other colors appear

yellow and are the most useful photographic filters. The K2, Kodak Color Filter, CK-3, and G filters absorb the ultraviolet completely while the K1 absorbs only part of it. All stop the blue to some extent. Those filters absorbing some of the red rays in addition to the ultraviolet and blue are the X1 and X2 light green filters.

It is well to note here that photographic lenses themselves absorb all the ultraviolet rays shorter in wave length than 330 to 350  $m\mu$ , depending on the type and thickness of glass used.

For correct monochromatic rendering (that matching most closely the daylight color response of the eye) with panchromatic emulsions of Types B and C\*, the following filters should be used:

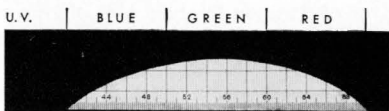


Figure 6—Sensitivity of the Eye

- K2 filter with Type B materials in daylight.
- X1 filter with Type B materials in tungsten light.
- X1 filter with Type C materials in daylight.
- X2 filter with Type C materials in tungsten light.

In dealing with filters, the terms "overcorrect" and "undercorrect" are frequently and loosely used. Undercorrection usually means that the rendering resembles that of non-color-sensitized films—blues too light; greens, yellows, and reds too dark. Overcorrection usually signifies the reverse—blues too dark; greens, yellows, and reds too light. Both terms are more correctly applied to some one color, rather than all colors.

### Contrast Filters

Contrast filters are used to lighten or darken certain colors in the subject for the purpose of introducing a brightness difference between two colors which would otherwise photograph nearly the same.

To the eye, objects are distinguished from their surroundings by contrast which may be of two kinds. It may be a tone contrast or a color contrast. Depending on the photographic method used, tone contrasts can be correctly reproduced, or color contrasts can be subdued or exaggerated as desired.

Thus, a red apple and its green leaves may photograph without a filter as two nearly similar tones of gray. Through the Wratten A (red) Filter, which transmits the red of the apple and absorbs the green of its leaves, the apple will be rendered light and the leaves dark; thereby a contrast which was present visually is restored. Use of the Wratten B

\*See pp. 18-19 for tables of sensitizing types and filter factors for all Kodak negative materials.

(green) Filter, which absorbs the red of the apple while transmitting the green of its leaves, produces the opposite result. The approximate effect of the Wratten A, B, C-5 and G filters can be predetermined visually by means of the Contrast Viewing Kodaguide.

A discussion of the principles of contrast filters, with specific recommendations for various commercial subjects, appears on pages 15 to 17.

### Sky Brightness Control

One of the most frequent uses of correction and contrast filters is to darken a blue sky to make white clouds stand out more prominently or to lend emphasis to the subject seen against the sky. In black-and-white photography, yellow or red filters are used for this purpose and their effectiveness depends upon the blueness of the sky. In some cases, the sky is not reproduced as dark as might be expected, under which conditions any one of the following factors may be responsible:

1. A misty sky does not photograph so dark as a clear sky. An overcast sky is darkened very little by filter application.
2. The sky is frequently almost white at the horizon and shades to more intense blue at the zenith. Therefore, the filter effect at the horizon is small and becomes increasingly greater as the camera is aimed upwards.
3. The sky near the sun is brighter and less blue than elsewhere, and is, therefore, less affected by the use of a filter.
4. The depth of filter (whether yellow or red) and the film used affect the rendering of the sky. A blue sky is increasingly darkened by the following film and filter combinations.

<i>Negative Material</i>	<i>Filter</i>	<i>Monochromatic rendering of a Clear Blue Sky</i>
Non-Color-Sensitized	None	Lighter than correct
Orthochromatic	None	Lighter than correct
Panchromatic	None	Lighter than correct
Orthochromatic	K2	Practically correct
Panchromatic	K2	Practically correct
Panchromatic	G	Darker than correct
Panchromatic	A	Very dark
Panchromatic	F	Almost black
Infrared-Sensitive	A	Black

5. The exposure has some influence on the result. Slight underexposure of the negative or dark printing appears to darken further a sky already rendered slightly dark by the use of a filter.

Overexposure of the film results in a lighter sky, and the filter effect may appear to be lost.

6. The contrast between the sky and the subject in the final print naturally depends on the lightness or darkness of the subject. With panchromatic film, the sky may be rendered dark in contrast to a light-colored subject, such as white blossoms or snow-covered trees, even when no filter is used.

The Kodak Sky Filter is a filter of special design for darkening the sky. It is a divided filter, the top half being light yellow, the bottom half clear, and the whole cemented between "B" glass. As illustrated in Figure 7, this design permits filtering the sky without affecting the foreground, so that no increase in exposure is necessary. Thus the Sky Filter is especially valuable when Kodak Verichrome Film is used in cameras having simple lenses and shutters with which an increase in exposure is either inconvenient or impossible.

The Kodak Sky Filter owes its effectiveness to the fact that it is separated from the lens diaphragm and that small diaphragm openings are required for sunlit landscapes (see Figure 7, below).

Another method of darkening the sky is by means of the Kodak Polar-Screen described on page 38. This is advantageous in black-and-white photography when the use of a yellow or red filter noticeably distorts

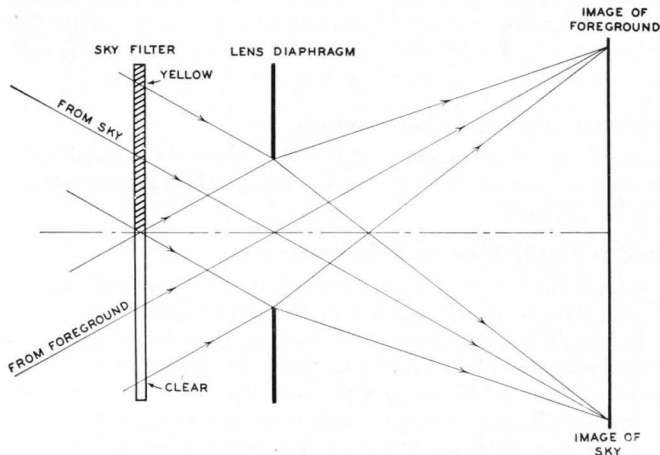


Figure 7—The Principle of the Kodak Sky Filter



the color rendering of the foreground subject. Moreover, the Pola-Screen offers the only known means of darkening a blue sky with Kodachrome Film. The Pola-Screen has its greatest effect on that band of the sky which is at right angles to the rays of the sun.

### **Haze Filters**

Distant landscapes and aerial views from high altitudes appear veiled by bluish haze, even on clear days. When photographed without a filter, this veiling hides some of the detail visible in the original scene. The contrast of distant detail is degraded because the image of the haze between the scene and the camera becomes superimposed upon the image of the distant detail. True atmospheric haze is bluish and is caused by light being scattered by very small particles of dust and water vapor and to some extent by the air itself. The blue color of the sky is principally due to the scattering of blue light by the molecules of the air.

Atmospheric haze should not be confused with mist or fog, both of which are white and are composed of water droplets. True atmospheric haze scatters very little red light, some green light, more blue light, and a large amount of ultraviolet, which in photography is more important than the visible haze. Since all photographic materials are highly sensitive to violet and ultraviolet, unfiltered pictures of distant landscapes record more haze than is visible. If the photograph is taken by light of longer wave length (green, red, etc.), the amount of recorded haze decreases. The amount of recorded haze decreases steadily in the order of the list given under "Sky Brightness Control."

### **Filters for Color-Separation Negatives**

Matched sets of red, green, and blue filters are used for making tri-color-separation negatives for color printing. These are described in the Data Sheets.

### **Neutral Density Filters for Reducing Exposure**

The most frequent need for a neutral density filter arises when Ciné-Kodak pictures are to be made in sunlight on Ciné-Kodak Super-XX Film. As the smallest aperture available on some lenses,  $f/16$ , is too large for scenes in bright sunlight, a gray filter known as the Neutral Density Filter No. 2 is supplied to reduce the exposure to one-fourth.

Occasionally one encounters very brilliant subjects, such as blast furnaces or arc welding operations, which require dense neutral density filters. Neutral Density Filters, No. 96, are supplied in nineteen

standard densities. Additional information can be obtained from the Sales Service Division, Rochester 4, New York. Two Pola-Screens together may also be used as a neutral density filter. When the indicator handles are parallel, the density of the combination is low, and the exposure increase required is about 6 times. This exposure factor can be varied by adjusting the angle between the indicator handles. At 75°, the factor is 60.

## THE HANDLING OF FILTERS

**Wratten Gelatin Film Filters** are extremely fragile and must be treated with great care. Moisture and contact with the fingers leave indelible marks. Loose dust can be removed with a soft, dry, camel's-hair brush, but the gelatin can be cleaned in no other way.

Gelatin filters should be touched only at the edges and should be handled and cut while between sheets of paper. These filters should be stored in dust-free containers in a cool, dry place.

Gelatin filters can be used conveniently at the lens in Wratten Gelatin Filter Frames, available in two sizes to hold 2 and 3-inch gelatin squares. Kodak Gelatin Filter Frame Holders are also supplied in these two sizes to fit, respectively, the Series VI and Series VIII Kodak Combination Lens Attachments. For temporary use, (1) gelatin filters can be mounted in cardboard; (2) a circle of the filter can be cut to fit between lens elements; or (3) the filter can be simply taped over the lens.

**Cemented Wratten Filters** are precision units and should be treated as carefully as fine lenses. They can be cleaned with a soft cloth (slightly moistened with Kodak Lens Cleaner, which should not be permitted to touch the cemented edges of the filter) and polished with Kodak Lens Cleaning Paper. Cemented filters should never be subjected to excessive heat and should be stored in clean, dry containers such as the boxes in which they are sold.

## SELECTION OF FILTERS

### *For Outdoor Subjects*

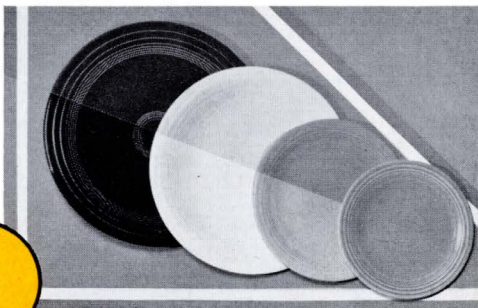
In the following table are a number of subjects commonly encountered in outdoor photography and filters suggested for each. Where the K2, G, or C5 filter is indicated, either Verichrome or a panchromatic film can be used. Where the X1, A, or F filter is listed,

# COLOR RENDERING

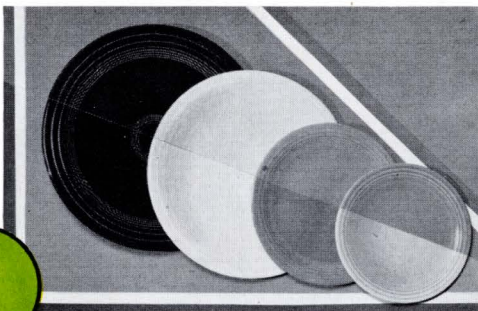
Type B Panchromatic Film



COLOR REPRODUCTION OF ORIGINAL



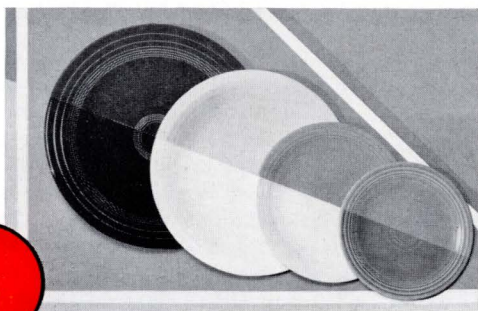
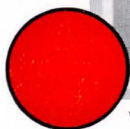
WRATTEN G FILTER (No. 15)



WRATTEN XI FILTER (No. 11)

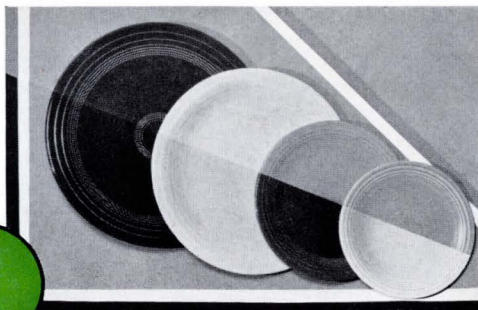
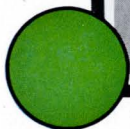
# with VARIOUS FILTERS

Photoflood Illumination



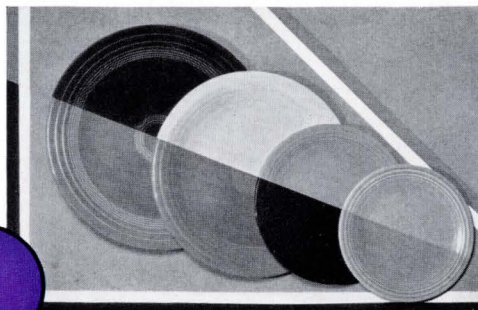
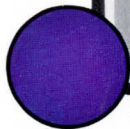
◀ NO FILTER

WRATTEN A FILTER (No. 25)



◀ NO FILTER

WRATTEN B FILTER (No. 58)



◀ NO FILTER

WRATTEN C5 FILTER (No. 47)

a panchromatic film must be used. Due to the impurity of colors occurring in nature, it is not always easy to tell just what filter will accomplish the desired result. Blue objects, for example, may also reflect a great deal of green light which, due to the predominance of blue, is not apparent to the eye. Where there is some doubt as to the proper choice of filter, it is wise to repeat the picture for each filter indicated and select the best result afterwards. In many cases the variations will be small but may make the final difference between a beautiful picture and a mere record.

<b>SELECTION OF FILTERS FOR OUTDOOR USE</b>		
<i>Subject</i>	<i>Effect Desired</i>	<i>Suggested Filter</i>
Clouds against Blue Sky	Natural	K2
	Darkened	G
	Spectacular	A
	Almost Black	F
Blue Sky as Background for Other Subjects	Night Effect	A plus Pola-Screen, A or F with Infrared Material
Marine Scenes when Sky is Blue	Natural	K2
	Water Dark	G
Sunsets	Natural	None or K2
	Increased Brilliance	G or A
Distant Landscapes	Addition of Haze for Atmospheric Effects	C5
	Very Slight Addition of Haze	No Filter
	Natural	K2
	Haze Reduction	G
	Greater Haze Reduction	A or F
	Haze Elimination	A or F with Infrared Material
Nearby Foliage	Natural	K2 or X1
	Light	B, or G with Verichrome Film
Outdoor Portraits Against Sky	Natural	X1, K2, or Pola-Screen
Flowers		
Blossoms and Foliage	Natural	K2 or X1
Red, "Bronze," Orange and Similar Colors	Lighter to Show Detail	A
Dark Blue, Purple and Similar Colors	Lighter to Show Detail	None or C5
"Foliage" Plants	Lighter to Show Detail	B, or G with Verichrome Film
Architectural Stone, Wood, Fabrics, Sand, Snow, etc., when Sunlit and Under Blue Sky	Natural	K2
	Enhanced Texture Rendering	G or A

## **FILTERS IN COMMERCIAL PHOTOGRAPHY**

FILTERS have numerous applications in commercial photography. The following material describes the principles involved in the commercial use of filters, and provides specific recommendations for some of the more common subjects.

Kodak panchromatic negative materials which are most suitable for general commercial work with filters are as follows: Films—Super-XX, Panatomic-X, Tri-X, Super Panchro-Press; Plates—Tri-X, Panatomic-X, Kodak Panchromatic. Tables of color sensitivity and filter factors of Kodak negative materials appear on pages 18 and 19.

### **General Principles of Contrast Filters**

1. A colored object appears dark in the print if the negative is exposed through a filter which absorbs the color of the object. The filter allows only a little of the light reflected from this object to reach the film, so that the object appears darker in the print than in the original subject.

Consider the application of this principle to photographing blueprints. The blue field should be made as dark as possible compared with the white lines. As a red filter absorbs blue light, the best contrast will be produced on panchromatic film with the Wratten A or F Filter. A green filter would do as well if the blue of the blueprint were a very pure color, but it reflects some green light, and therefore the contrast would not be so high with the green filter.

2. A colored object appears light in the print if the negative is exposed through a filter which transmits the color of the object. For example, consider photographing a yellowed document. With a G (yellow) filter, which transmits yellow freely, a panchromatic negative material reproduces this paper as white.

3. To show the best detail within a colored object, photograph that object to appear light, as above. Thus, dark green leaves show best detail when the negative is exposed through a green filter, on panchromatic material, or through a deep yellow filter on orthochromatic material (another method of photographing by green light).

### **Selection of Filters in Commercial Work**

The ability to select the proper filter for a multicolored subject requires experience and judgment. No single rule can be applied, but the following procedure is suggested.

The subject should first be carefully examined to determine how the various colors must be rendered in order to show a pattern or texture, or

in order to make an object stand out from or blend with surrounding objects and background. It may be obvious that certain colors should be lightened, and others darkened, to achieve the desired effect. If so, the proper filter can be selected by one of the three methods below:

a. Visual examination of the subject through various filters, such as the G, A, B, and C5. These filters are included in the Contrast Viewing Kodaguide, and an examination of the scene through them will indicate whether one of the contrast filters is required.

b. Comparison of the rendering of subject colors by each filter as shown on the Wratten Filter Kodaguide. Note again that a given color photographs light through a filter which transmits that color, and dark through a filter which absorbs that color.

c. Actual trial of the filters indicated by such visual examination, processing of negatives, and inspection of test prints.

If it is not evident what colors should be rendered lighter or darker than normal, photograph the subject on a Type B panchromatic film such as Kodak Super-XX Sheet Film without a filter. In tungsten light, this produces monochromatic rendering approximately equivalent to the brightness values of colors as seen by the eye, and in a majority of cases this rendering will be satisfactory. If, however, some of the colors appear to be too light or too dark, a filter for a second negative can be chosen as above.

For most accurate monochromatic rendering, such as may be required in photographs which are subsequently to be hand-colored, follow the recommendations on pages 6 and 7.

<b>FILTER RECOMMENDATIONS FOR COMMERCIAL SUBJECTS</b> <b>(With Type B Panchromatic Material Unless Otherwise Specified)</b>		
<i>Subject</i>	<i>Effect Desired</i>	<i>Suggested Filters</i>
<b>ARCHITECTURE:</b> Light-colored buildings against blue sky	Separation between building and sky.	K2
	Greater contrast between building and sky.	G
	Dark sky.	A
	Darker sky with any of above filters.	Pola-Screen
Red brick buildings	Lightening of tone to show texture.	G
Reflections from roofs and windows	To subdue.	Pola-Screen

# **FILTER RECOMMENDATIONS FOR COMMERCIAL SUBJECTS**

(Continued)

<i>Subject</i>	<i>Effect Desired</i>	<i>Suggested Filters</i>
<b>AUTOMOBILES:</b> Dark colors	Lightening of tone to show shape and detail	Filter similar to color of car
Lettering on trucks, busses, etc.	Contrast to increase legibility	See page 15
Reflections from lacquered surfaces	To subdue	Pola-Screen
<b>COLORED CHINA, GLASS, PLASTICS, POTTERY, TILE, MOSAICS:</b>	Natural rendering	K2 or X1, see p. 6
	Contrast to show pattern or indicate color contrast	See page 15
Reflections	To subdue	Pola-Screens at lens and lights
<b>FABRICS, CLOTHING, TAPESTRIES, UPHOLSTERED FURNITURE:</b>	Natural rendering	K2 or X1, see p. 6
	Contrast to show pattern or indicate color contrast	See page 15
Dark colors	Lightening of tone to show texture	Filter similar to color of material
<b>FURNITURE:</b> Red woods, as mahogany and rosewood	Best rendering of wood grain	A
Yellow woods and others, as maple, walnut, oak, etc.	Best rendering of wood grain	G with Commercial Ortho Film
Wood furniture with other colors, as in a room setting	Best grain with good rendering of other colors	K2 or G
<b>LEATHER, LINOLEUM, WALLPAPER:</b>	Natural rendering	K2 or X1, see p. 6
	Contrast to show pattern or indicate color contrast	See page 15
Colored leather with chromium	Lightening of leather so image of metal detail will print	Filter similar to color of leather
Reflections from linoleum	Subdue reflections which obscure pattern	Pola-Screen
<b>PACKAGING:</b> Colored boxes	To separate light reds from other colors	X1 or K2
	To make lettering more readable, or to separate various colored parts of package design	See page 15
	Penetration of colored acetate sheeting to show material or detail within	Filter similar to color of sheeting
	To subdue reflections from Kodapak or other clear sheeting	Pola-Screen



**FILTER FACTORS FOR KODAK FILMS AND PLATES***Color sensitivity of Kodak negative materials is indicated on next page.*

Filter	Color of Filter	No.	Non-Color-Sens.		Orthochromatic		Pan B		Pan C		Filter
			Sunl't	Tung.	Sunl't	Tung.	Sunl't	Tung.	Sunl't	Tung.	
Aero 1 Kodak Color Aero 2	Light Yellow Yellow Yellow	3	4	3	2	1.5	1.5	...	1.5	...	Aero 1 Kodak Color Aero 2
		4	8	5	2	1.5	1.5	1.5	1.5	1.5	
		5	20	16	2.5	2	2	...	2	...	
K1 K1½ K2 K3 CK-3	Light Yellow Light Yellow Yellow Yellow Deep Yellow	6	4	3	2	1.5	1.5	1.5	1.5	1.5	K1 K1½ K2 K3 CK-3
		7	8	5	2	1.5	1.5	1.5	1.5	1.5	
		8	12	10	2.5	2	2	1.5	2	1.5	
		9	20	16	2.5	2	2	1.5	2	1.5	
		..	...	...	...	...	2	1.5	2	1.5	
X1 Minus Blue X2 G E L	Light Green Yellow Green Deep Yellow Red Blue	11	...	...	...	...	3	2	4	3	X1 Minus Blue X2 G E L
		12	...	...	3	2.5	2	1.5	2	1.5	
		13	...	...	...	...	5	3	6	4	
		15	...	...	5	3	3	2	2.5	2	
		23	...	...	...	...	5	4	4	2	
		50	...	...	...	...	25	40	25	40	
A B C5	Red Green Blue	25	...	...	...	...	8	4	4	2	A B C5
		58	...	...	8	5	8	8	8	6	
		47	2.5	2.5	3	4	5	10	5	10	
F N C4	Deep Red Green Blue	29	...	...	...	...	16	8	8	4	F N C4
		61	...	...	...	...	10	10	10	8	
		49	6	6	10	12	12	25	12	25	
Kodak Pola-Screens	Gray	..	...	...	2.5	2.5	2	2	2	2	Kodak Pola Screens

# CLASSIFICATION OF KODAK SENSITIVE MATERIALS

## For Assignment of Filter Factors

### Non-Color-Sensitized

FILMS: Commercial  
Commercial Matte  
Positive  
High Contrast Positive

PLATES: Kodak 40      Kodak Process  
Kodak 33      Kodak Lantern Slides (Medium, Contrast, Contrast Anti-Abrasion)

### Orthochromatic

FILMS: Super Speed Ortho Portrait  
Contrast Process Ortho  
Commercial Ortho

Verichrome  
Super Ortho-Press  
Ortho-X

PLATES: Polychrome  
Commercial  
Kodak 50  
Kodak Metallographic  
Super Ortho-Press

### Pan B

FILMS: Super-XX Sheet Film  
Super-XX 35-mm and Bantam  
Plus-X Roll, Pack, 35-mm, and Bantam  
Panatomic-X Sheet Film, 35-mm, and Bantam  
Portrait Pan  
Micro-File  
Contrast Process Pan  
Super Panchro-Press, Type B  
Super Panchro-Press, Sports Type

PLATES: Kodak Process Pan      Kodak "M"  
Kodak Panatomic-X      Kodak Pan  
Kodak Tri-X Pan, Type B  
Kodak Tri-X Pan, Type B, Matte

### Pan C

FILMS: Super-XX Roll and Pack      Ciné-Kodak 8 Pan  
Tri-X Pan      Ciné-Kodak 8 Super-X  
Direct Positive Pan      Ciné-Kodak Super-X  
Ciné-Kodak Super-XX

PLATES: Kodak Super Panchro-Press

# OUTDOOR PICTURES WITH VARIOUS FILTERS



No filter



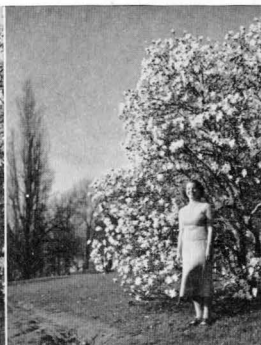
Effect obtainable with X1 filter  
or Pola-Screen

Negatives made on a Type C panchromatic material

*The X1 filter darkens the sky without adversely affecting color rendering of the subject*

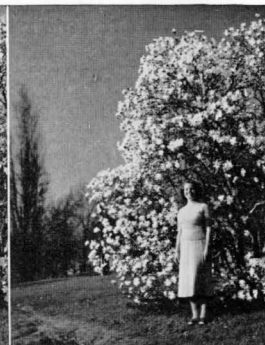


No filter



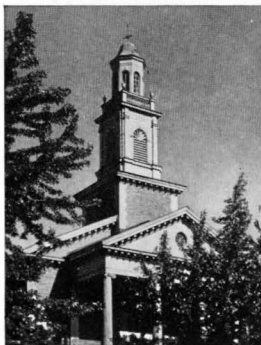
K2 filter

Negative made on an orthochromatic material

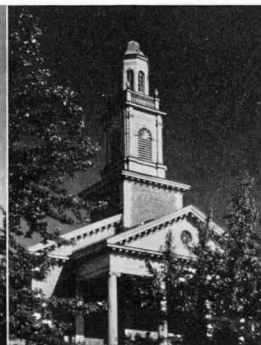


K2 and Pola-Screen

*Darkening sky to accentuate blossoms. (Kodak Color Filter gives approximately the same effect as the K2.)*



No filter



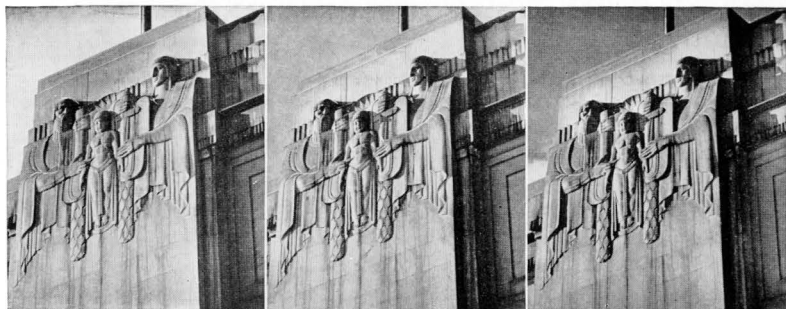
Pola-Screen

Negatives made on a panchromatic material



Pola-Screen and "A" filter

*Controlling sky brightness over a wide range is possible with the Pola-Screen when photographing at right angles to the sun's rays. Night effects are obtained with the Pola-Screen and A filter together.*



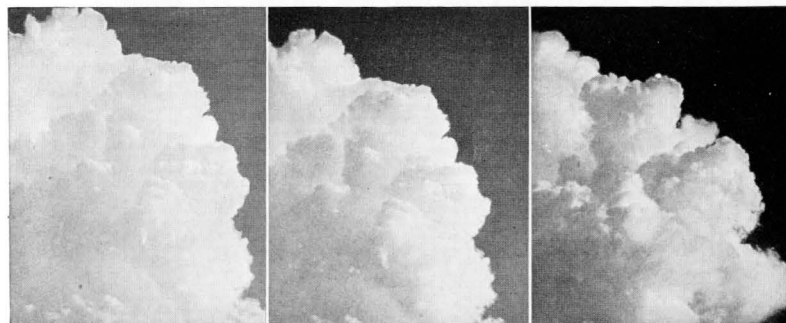
No filter

G filter

"A" filter

Negatives made on a Type B panchromatic material

The G and "A" filters add increasing emphasis to modeling and texture in sunlit subjects under a blue sky.



No filter

K2 filter

"A" filter

Negatives made on a Type C panchromatic material

Clouds are rendered correctly with the K2 filter, and spectacularly with the "A" filter.



Above, K2 filter; below, no filter

Above, G filter; below C5 filter

Negatives made on a Type C panchromatic material

Control haze effect by filters. C5 adds aerial perspective; K2 and G show increasing penetration.

## KODAK COMBINATION LENS ATTACHMENTS

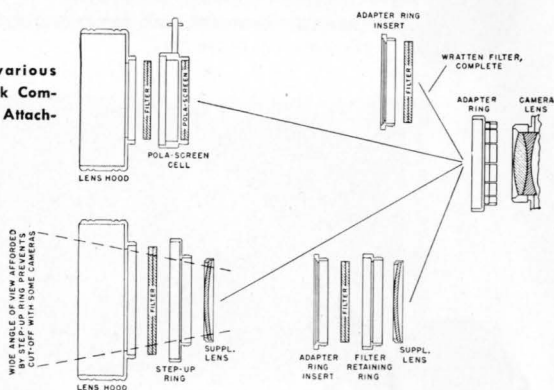
KODAK Combination Lens Attachments cover a wide range of lens sizes, and facilitate the use, singly or in combination, of filters, supplementary lenses, diffusion disks, Pola-Screens, and Lens Hood—as listed on the following page. Because this system permits the interchange of several unmounted optical units, it offers maximum economy when more than one such accessory would be regularly used.

The Adapter Ring is slipped on over the lens mount, and serves as the basic attachment of the assembly. The Adapter Ring includes an Adapter Ring Insert which holds in position a filter, a supplementary lens, or a diffusion disk. If a Lens Hood is added to the assembly the Adapter Ring Insert is not used. A filter and a supplementary lens, or diffusion disk, can be used together by means of the Retaining Ring or Step-Up Ring. The Step-Up Ring also permits attachments in one size to be used with an Adapter Ring of smaller size. Filters in “B” glass, unmounted, are available in wide variety, as listed.

*Kodak Portra Lenses* are used for making portraits or photographs of small objects at short distances in order to secure larger images in sharp focus. The Portra lenses can be used according to tables supplied in the instruction sheets, or simply according to the image in the ground glass of cameras so equipped. *Kodak Telek Lenses* provide a telephoto effect, that is, larger images of distant subjects. The Telek lenses must be used with cameras having sufficient lens extension and a ground glass, so that focus can be set according to the ground glass image.

The *Kodak Pictorial Diffusion Disk* is used to secure a soft-focus effect in landscape photographs. The *Kodak Portrait Diffusion Disk* combines the close-up ability of a Portra lens, above, with a soft-focus effect.

**Illustrating various uses of Kodak Combination Lens Attachments.**



# DATA ON KODAK COMBINATION LENS ATTACHMENTS

Kodak Adapter Rings For lenses with outside lens-mount diameter from	Series V		Series VI		Series VII		Series VIII	
	$\frac{3}{4}$ to $1\frac{1}{8}$ in.		$1\frac{1}{4}$ to $1\frac{3}{4}$ in.		1 $\frac{1}{8}$ to 2 in.		2 $\frac{1}{8}$ to $2\frac{5}{8}$ in.	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.
All Adapter Rings are of the "slip-on" type except "screw-in" type No. 18 for Elmar f/3.5 Lens; No. 19 for Super Nettel with Tessar f/3.5 Lens; No. 21 For Kodak Retina I; No. 24 for Kodak Ektra with f/1.9 lens; No. 25 for Kodak Ektra with f/3.5 50-mm lens; and No. 26 for Kodak Ektra with f/3.3 lens. All Adapter Rings include an Adapter Ring Insert* to hold filter or supplementary lens. If no Adapter Ring listed provides an exact fit, select the next larger listed size (within $\frac{1}{32}$ -inch).	$\frac{3}{4}$	19.0	$1\frac{1}{4}$	31.5	$1\frac{1}{8}$	42.5	$2\frac{1}{8}$	52.0
	$\frac{13}{16}$	20.5	$1\frac{1}{2}$	33.0	$1\frac{3}{8}$	44.5	$2\frac{1}{4}$	54.0
	$\frac{7}{8}$	22.0	$1\frac{5}{8}$	35.0	$1\frac{1}{2}$	46.0	$2\frac{3}{8}$	55.5
	$\frac{15}{16}$	23.5	$1\frac{3}{4}$	35.5	$1\frac{5}{8}$	47.5	$2\frac{1}{2}$	57.0
	1	25.5	$1\frac{7}{8}$	36.5	$1\frac{3}{4}$	49.0	$2\frac{5}{8}$	58.5
	$1\frac{1}{32}$	26.0	$1\frac{15}{16}$	37.0	2	50.5	$2\frac{7}{8}$	60.0
	$1\frac{1}{16}$	27.0	$1\frac{1}{2}$	38.0			$2\frac{1}{2}$	62.0
	$1\frac{1}{8}$	28.5	$1\frac{1}{4}$	39.5			$2\frac{3}{4}$	63.5
	$1\frac{1}{4}$	30.0	$1\frac{1}{2}$	41.0			$2\frac{5}{8}$	67.0
	No. 18 (Screw-In)		$1\frac{3}{4}$	42.0				
	No. 19 (Screw-In)		No. 24 (Screw-In)					
	No. 21 (Screw-In)		No. 19 (Screw-In)					
			No. 25 (Screw-In)					
			No. 26 (Screw-In)					
<b>Filters (in "B" glass, unmounted)</b>								
Wratten A, B, C4, C5, F, G, K1, K2, K3, N, X1, X2, No. 1, No. 2A, 80, 85, 85B, 87, Aero 1, Aero 2, 23A, Kodak Color Filter, Kodak Sky Filter, Kodachrome Haze Filter, Kodachrome Filter for Photoflood, Type A Kodachrome Filter for Daylight, Type B Kodachrome Filter for Daylight. . . . . All Series								
CK-3 and ND-2. . . . . V, VI, VII								
Kodak Color Compensating Filters: CC3, CC4, CC5, CC6, CC13, CC14. . . . . VI, VII								
CC15. . . . . VI, VII, VIII								
CC23, CC24, CC25, CC33, CC34, CC35, CC43, CC44, CC45. . . . . V, VI, VII, VIII								
Set of 7 with case—CC3, CC4, CC5, CC6, CC13, CC14, CC15. . . . . VI, VII								
<b>Diffusion Disks</b>								
Kodak Portrait Diffusion Disk. . . . . V, VI								
Kodak Pictorial Diffusion Disk. . . . . V, VI, VII								
<b>Supplementary Lenses</b>								
Kodak Portra Lenses 1+, 2+ (For close-ups). . . . . V, VI, VII								
Kodak Portra Lenses 3+ (For close-ups). . . . . V								
Kodak Telek Lenses 1-, 2-, 3-, 4- (For distant subjects). . . . . VI, VII								
<b>Kodak Lens Hood</b> . . . . . All Series plus VI-A (VI-A required for Kodak Bantam Special or Retina II)								
<b>Kodak Pola-Screen</b> . . . . . All Series Kodak Pola-Screen Viewer fits handle of Pola-Screen, all series.								
<b>Kodak Retaining Ring</b> . . . . . All Series Permits two attachments to be used together. (e.g. supplementary lens and filter.) See illustration.								
<b>Kodak Step-Up Rings</b> . . . . . V-VI, VI-VII, VII-VIII Permit attachments in one Series size to be used in combination with an Adapter Ring in the next smaller Series size. One set of attachments can thus be made to serve several cameras. The Step-Up Ring can also be used to prevent cut-off, which occurs with some lenses when two attachments are used simultaneously. See illustration.								
<b>Kodak Gelatin Filter Frame Holder</b> —Series VI, accepts 2-inch Wratten Gelatin Filter Frame. Series VIII, accepts 3-inch Wratten Gelatin Filter Frame.								
*Adapter Ring Inserts have the following V-threads (36 per inch): Ser. V—1.319 in.; Ser. VI—1.752 in.; Ser. VII—2.146 in.; Ser. VIII—2.638 in.								

## Ciné-Kodak Filters and Pola-Screens:

In addition to the Kodak Lens Attachments listed above, the CK-3, ND-2, and all Wratten Filters are supplied in the W, Z, and U11 mounts for Ciné-Kodaks and Ciné-Kodaks Eight. The Kodak Pola-Screen is supplied in the W mount.



24 FILTERS

Harkness Memorial Tower  
Yale University, New Haven, Conn.  
K-2 Filter and Pola-Screen, Plus-X

## Data—WRATTEN K1 FILTER (No. 6)

**Color:** Very light yellow. Absorbs some of the ultraviolet and some blue-violet rays.

**Negative Materials:** All panchromatic and orthochromatic materials.

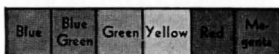
**Uses:** This filter affords partial correction. That is, it darkens a blue sky and shows up clouds, but not so much so as the K2 or the Kodak Color Filter. Red and yellow subjects, such as flowers, are rendered lighter than with no filter, but not so light as with the other two filters mentioned. The K1 filter is useful when some correction is desired, and short exposure is necessary.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

### Filter Factors:

		<i>Negative Material</i>	
		ORTHOCHROMATIC	PANCHROMATIC
			Type B      Type C
Sunlight:	2		1.5      1.5
Tungsten:	1.5		1.5      1.5

**Color Rendering** of brilliant printing inks in sunlight on Type B panchromatic film through K1 filter.

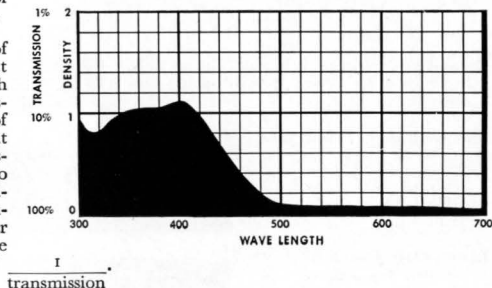


**Spectrogram** of Type B panchromatic film to tungsten light through K1 filter.



### Absorption Curve of Wratten K1 Filter.

**NOTE:** The height of the absorption curve at a certain wave length indicates both transmission and density of the filter to light of that particular color. Transmission equals the ratio of transmitted to incident light, and is usually expressed as a per cent. Density is the common logarithm of





## Data—WRATTEN K2 FILTER (No. 8) AND KODAK COLOR FILTER

**Color:** Both are yellow. Both absorb ultraviolet and some blue-violet rays. K2 absorbs slightly more blue-violet than the Kodak Color Filter. These are both correction filters. The K2 filter affords complete correction in daylight with Type B panchromatic materials. The Kodak Color Filter affords slightly less correction. They are near enough alike, however, so that the color rendering and spectrogram shown for the K2 filter will apply to the Kodak Color Filter.

**Negative Materials:** All panchromatic and orthochromatic materials.

**Uses:** (1) Darkening a blue sky to obtain cloud effects; (2) photographing through distant haze; (3) photographing foliage and grass to render it lighter than without a filter; (4) photographing gardens; and (5) photographing any scenery (distant or close) where colors, especially greens, yellows, and reds, are predominant. Among the subjects to which these filters are particularly adaptable, the more important are:

DISTANT VIEWS	YACHTING SCENES	CLOUDS WITH BLUE SKY
LANDSCAPES	MARINE VIEWS	SNOW SCENES
BEACH SCENES	SUNSETS	MOUNTAINS

In addition, the K2 filter is valuable in much outdoor commercial work, such as architecture, and in the studio when a light rendering of red and yellow objects is required, but not so light a rendering as given by the G filter.

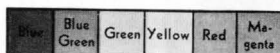
**Available Forms:** K2: Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

Kodak Color Filter: Cemented in B glass only.

### Filter Factors:

		<i>Negative Material</i>	
		ORTHOCROMATIC	PANCHROMATIC
			Type B      Type C
WRATTEN K2 FILTER			
Sunlight:	2.5		2      2
Tungsten:	2		1.5      1.5
KODAK COLOR FILTER			
Sunlight:	2		1.5      1.5
Tungsten:	1.5		1.5      1.5

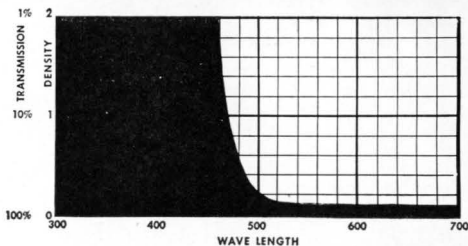
**Color Rendering** of brilliant printing inks in sunlight on Type B panchromatic film through K2 filter.



**Spectrogram** of Type B panchromatic film to tungsten light through K2 filter.



**Absorption Curve** of Wratten K2 Filter.



## Data—WRATTEN K3 FILTER (No. 9)

**Color:** Deep yellow.

**Negative Materials:** All orthochromatic and panchromatic materials.

**Uses:** Produces a darker rendition of blues than K2 for sky effects. Used to photograph blue or purple type as black in photomechanical work.

**Filter Factors:**

*Negative Materials*

ORTHOCHROMATIC

PANCHROMATIC

Sunlight: 2.5  
Tungsten: 2

Type B 2  
1.5  
Type C 2  
1.5

**Spectrogram:** Type B panchromatic film to tungsten light through the K3 filter.



## Data—WRATTEN AERO 1 FILTER (No. 3)

**Color:** Light yellow. Absorbs ultraviolet, violet, and some blue.

**Negative Materials:** All panchromatic and orthochromatic materials.

**Uses:** Particularly for aerial photography to penetrate slight haze, or at low altitudes where very short exposure is required to overcome rapid motion of the plane relative to the ground. Used also by professional motion-picture photographers where light yellow filter is required.

**Filter Factors:**

*Negative Materials*

ORTHOCHROMATIC

PANCHROMATIC

Sunlight: 2  
Tungsten: 1.5

Type B 1.5  
..  
Type C 1.5  
..

**Spectrogram:** Type B panchromatic film to tungsten light through Aero 1 filter.



## Data—WRATTEN AERO 2 FILTER (No. 5)

**Color:** Yellow. Absorbs ultraviolet, violet, and some blue.

**Uses:** Aerial photography for greater haze penetration than Aero 1 filter where slightly longer exposure can be tolerated as from higher altitudes. Also widely used by professional cinematographers for pleasing sky effects.

**Filter Factors:**

*Negative Materials*

ORTHOCHROMATIC

PANCHROMATIC

Sunlight: 2.5  
Tungsten: 2

Type B 2  
..  
Type C 2  
..

**Spectrogram:** Type B panchromatic film through Aero 2 filter.



## Data—CINÉ-KODAK CK-3 FILTER

**Color:** Deep yellow. Absorbs ultraviolet, violet, and some of the blue rays.

**Sensitive Materials:** All Ciné-Kodak black-and-white films and panchromatic negative films.

**Uses:** The CK-3 filter is intended primarily for use with Ciné-Kodak and other amateur motion-picture cameras.

*Sky and Other Outdoor Contrast Effects:* The CK-3 filter renders a blue sky darker than normal to emphasize clouds or such foreground objects as buildings, people, trees, etc. In marine scenes, it darkens the water surface in proportion to the amount of blue light which the water reflects from the sky. Red and yellow subjects are rendered lighter, and blue subjects darker, than the eye sees them.

*Haze Penetration:* The CK-3 filter penetrates distant haze to a greater extent than the eye; therefore, it finds application in distant views, mountain scenery, etc.

*Telephoto Lenses:* Because of the effect of the CK-3 filter on haze, all distant scenes taken with Ciné-Kodak lenses of long focal length are benefited by the use of this filter. Such pictures taken without filters tend to lack contrast.

*Moonlight Effects:* When this filter is used with Ciné-Kodak Super-X and Ciné-Kodak Safety Films, moonlight effects are secured at  $f/16$ , in back-lighted marine scenes in sunlight.

**Available Forms:** As glass filters only in slip-on and adjustable mounts as currently listed.

**Filter Factors:** Sensitive Material: *Ciné-Kodak Super-XX, Ciné-Kodak Super-X, and other Type C panchromatic films*

Sunlight: 2

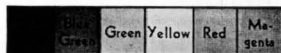
Tungsten: 1.5

*Panatomic-X, Plus-X and other Type B panchromatic films*

Sunlight: 2

Tungsten: 1.5

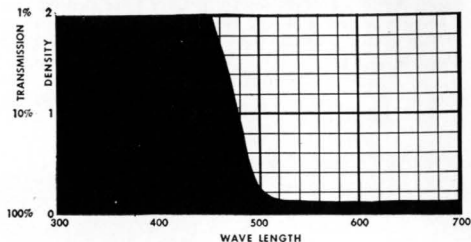
**Color Rendering** of brilliant printing inks in sunlight on panchromatic film through CK-3 filter.



**Spectrogram** of Type B panchromatic film to tungsten light through CK-3 filter.



**Absorption Curve** of CK-3 filter.



## Data—WRATTEN X1 FILTER (No. 11)

**Color:** Light green. Absorbs ultraviolet, violet, some blue, and some deep red.

**Negative Materials:** To be used with Types B and C panchromatic materials.

**Uses:** The X1 filter is used with Type C panchromatic film to obtain correct monochromatic rendering of multicolored subjects, such as flowers, photographed in daylight. The X1 filter is also recommended in preference to a yellow filter for making outdoor portraits against a sky. The use of a yellow filter in this instance may result in a chalky rendering of flesh tones.

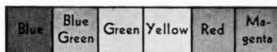
In addition, the X1 filter is the correction filter for Type B panchromatic materials in tungsten light. Where improvement in tone rendering is desired, the X1 filter should be tried before any of the contrast filters.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

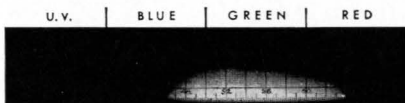
### Filter Factors:

	<i>Negative Material</i>	
	PANCHROMATIC	
	Type B	Type C
Sunlight:	3	4
Tungsten:	2	3

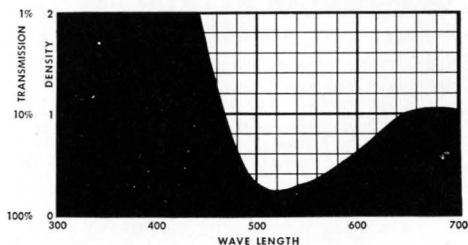
**Color Rendering** of brilliant printing inks under tungsten light on Type B panchromatic film through X1 filter.



**Spectrogram** of Type B panchromatic film to tungsten light through X1 filter.



**Absorption Curve** of Wratten X1 Filter.





(Photograph courtesy American Airlines, Inc.)

**"NIAGARA FALLS FROM THE AIR"**—From a Kodak panchromatic film negative exposed through a Wratten G Filter. The yellow filter helps penetrate the bluish atmospheric haze.

## Data—WRATTEN X2 FILTER (No. 13)

**Color:** Green. Similar absorption to X1, but transmits less red.

**Negative Materials:** Type C panchromatic materials in tungsten light.

**Uses:** The X2 filter is used with Type C panchromatic materials under tungsten light to reproduce monochromatically the colors of the subject in the same relative values as the eye would see them by daylight. The X2 filter prevents lips, cheeks, flowers, and other reds from photographing too light.

**Filter Factors:**

*Negative Materials*  
Type C PANCHROMATIC  
Tungsten: 4

**Spectrogram:** Type C panchromatic film to tungsten light through the X2 filter.



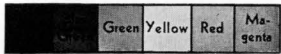
Data—WRATTEN G FILTER (No. 15)

- Color:** Deep yellow. Absorbs ultraviolet, violet, and most of the blue rays.
- Negative Materials:** All panchromatic and orthochromatic materials.
- Uses:** *Sky and Other Outdoor Contrast Effects:* The Wratten G Filter renders a blue sky darker than is correct in order to emphasize the foreground subject—a building, for example. In a similar way, in marine scenes, the G filter darkens the water surface. The bluer the water appears, the more pronounced is the effect. Thus, subjects on the water may be rendered light in contrast to the water. Red and yellow subjects, such as flowers, are rendered lighter than the eye sees them. Blue subjects are rendered darker than the eye sees them.
- Texture Rendering Outdoors:* The G filter produces an enhanced rendering of texture in sunlit outdoor subjects photographed under a blue sky. The small shadows which reveal texture are illuminated by bluish light from a blue sky; such shadows are intensified by any filter which absorbs blue light. The G filter, therefore, enhances the texture in such subjects as architectural stone, sand, fabrics, and so on, when photographed in sunshine under a blue sky.
- Haze Penetration:* The G filter penetrates distant haze to a greater extent than the eye—a valuable property in distant mountain and aerial photography.
- Telephoto Lenses:* Because of the effect on haze, all distant scenes taken with telephoto or other long-focus lenses are improved by the G filter. Telephoto pictures taken without filters tend to lack contrast. With lenses longer than 10 inches in focal length, gelatin filters or A glass filters should be used.
- Contrast Uses in the Studio:* In the studio, the G filter has two general uses; producing contrast between the blue parts and the yellow, brown, orange, or red parts of a subject, and producing detail in any yellow, brown, or orange subject. Showing grain in yellow and brown wooden furniture is an example of this.
- Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

Filter Factors:

	ORTHOCHROMATIC	Negative Material	
		PANCHROMATIC	
		Type B	Type C
Sunlight:	5	3	2.5
Tungsten:	3	2	2

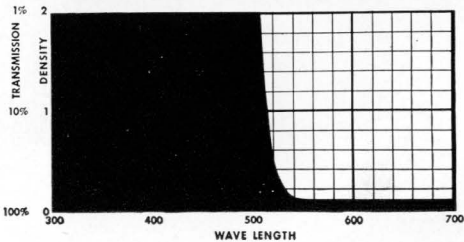
**Color Rendering** of brilliant printing inks under tungsten light on Type B panchromatic film through G filter:



**Spectrogram** of Type B panchromatic film to tungsten light through G filter.



Absorption Curve of Wratten G Filter.



## Data—WRATTEN A FILTER (No. 25)

**Color:** Red. Absorbs ultraviolet, blue-violet, blue, and green rays.

**Negative Materials:** All panchromatic films and plates.

**Uses:** *Sky and Other Outdoor Contrast Effects:* The A filter's applications outdoors are similar to those of the G filter, but the effects are more pronounced. As compared with the G filter, the A filter renders red and yellow objects lighter, blue objects darker, and enhances the texture of outdoor subjects. The A filter renders blue skies dark which is helpful in producing spectacular photographs of buildings and so forth. The A filter likewise penetrates aerial haze; green foliage, however, will be darkened. Slight underexposure through an A filter produces moonlight effects. This filter renders sunsets spectacular, for the red and yellow parts are reproduced bright against blue sky and gray clouds.

*Contrast Effects in the Studio:* In the studio, the A filter is most useful in producing contrast—for example, in photographing a blueprint to show the lines light against a dark background. The A filter renders blue and green as dark; and yellow, orange, and red as very light. This filter is also valuable in producing detail in brown or red subjects, such as mahogany furniture.

*Infrared Photography:* The A filter is also normally used with Kodak Infrared-Sensitive Plates and Kodak Infrared Films. The exposure time for such materials is the same whether the G, the A, or the F filter is used.

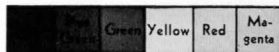
*Color-Separation Negatives:* The A is the red filter of the standard tricolor set.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

### Filter Factors:

	Negative Material	
	PANCHROMATIC	
	Type B	Type C
Sunlight:	8	4
Tungsten:	4	2

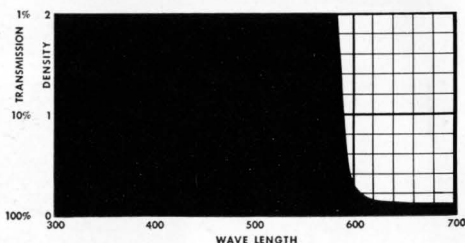
**Color Rendering** of brilliant printing inks under tungsten light for any panchromatic material through the Wratten A Filter.



**Spectrogram** of Type B panchromatic film to tungsten light through the Wratten A Filter.



**Absorption Curve** of Wratten A Filter.



## Data—WRATTEN F FILTER (No. 29)

**Color:** Deep red. Absorbs ultraviolet, blue-violet, blue, green and yellow-green rays.

**Negative Materials:** All panchromatic films and plates.

**Uses:** *Contrast Uses in the Studio:* The F filter's higher filter factor more or less confines its use to studio application with panchromatic materials, preferably Type C materials. The differences in rendering between the A and F filters are most noticeable in the rendering of greens and blue-green. The F filter in general renders such colors darker. Light blue subjects, such as blue typewriting, are rendered very dark.

Since this filter is a deeper red than the A, the effects with the F filter are more pronounced than with the A filter.

*Dark Sky Effects Outdoors:* When exposure time permits, the F filter can be used when a light subject is photographed against a blue sky to produce a very dark background.

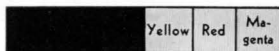
*Special Separation Negatives:* The F filter is useful along with the C4 (No. 49) and the N (No. 61) filters in making separation negatives from Kodachrome originals.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

### Filter Factors:

	Negative Material	
	PANCHROMATIC	
	Type B	Type C
Sunlight:	16	8
Tungsten:	8	4

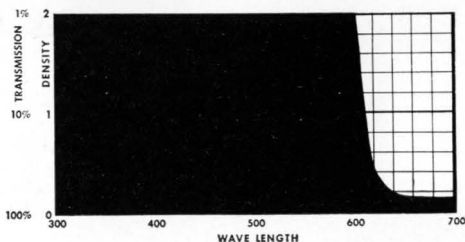
**Color Rendering** of brilliant printing inks under tungsten light on any panchromatic film through Wratten F Filter.



**Spectrogram** of Type B panchromatic film to tungsten light through the Wratten F Filter.



**Absorption Curve** of Wratten F Filter.





## Data—WRATTEN B FILTER (No. 58)

**Color:** Green. Absorbs ultraviolet, violet, blue, and red.

**Negative Materials:** All panchromatic films and plates.

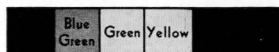
**Uses:** This is a contrast filter useful in rendering green subjects lighter than blue and red ones. Its use also results in good detail rendering in green subjects. Interesting photographs of trees against the sky can be made with the B filter. This filter is used with the A and the C5 filters in making separation negatives directly from original subjects.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

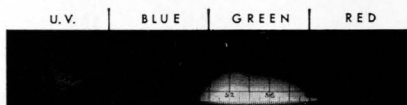
### Filter Factors:

	<i>Negative Material</i>			
	ORTHOCHROMATIC	PANCHROMATIC		
		Type B	Type C	
Sunlight:	8	7	7	
Tungsten:	5	7	6	

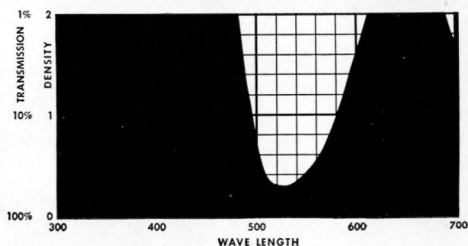
**Color Rendering** of brilliant printing inks under tungsten light with any panchromatic film through Wratten B Filter.



**Spectrogram** of Type B panchromatic film to tungsten light through Wratten B Filter.



**Absorption Curve** of Wratten B Filter.



## Data—WRATTEN C5 FILTER (Wratten No. 47)

**Color:** Blue. Absorbs red, yellow, green, and ultraviolet.

**Negative Materials:** Orthochromatic and panchromatic.

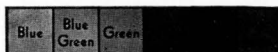
**Uses:** This is primarily the blue filter for direct separation negatives, but it serves as a contrast filter when blue subjects are to be rendered as light as possible. Results with the C5 filter and panchromatic film are very similar to those obtained on non-color-sensitized film with no filter. In outdoor photography the C5 filter enhances aerial haze and thus adds "atmospheric quality" to pictorial landscapes.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes.

### Filter Factors:

	<i>Negative Material</i>		
	ORTHOCHROMATIC	PANCHROMATIC	
		Type B	Type C
Sunlight:	3	5	5
Tungsten:	4	10	10

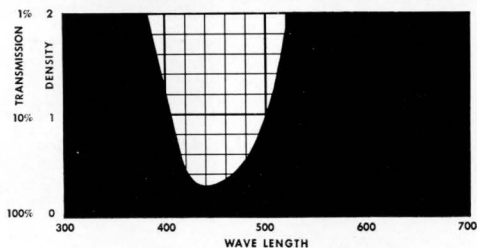
**Color Rendering** of brilliant printing inks under tungsten light on any panchromatic film through Wratten C5 Filter.



**Spectrogram** of Type B panchromatic film to tungsten light through Wratten C5 Filter.



**Absorption Curve** of Wratten C5 Filter.



## Data—WRATTEN TRICOLOR FILTERS

### (For Color-Separation Negatives From Subject)

Filter	Number	Color
A	Wratten No. 25	Red
B	Wratten No. 58	Green
C5	Wratten No. 47	Blue

**Negative Materials:** Kodak Tri-X Panchromatic Film, Kodak Tri-X Panchromatic, Type B, Plates.

**Uses:** These filters comprise the standard set for making color-separation negatives from original subjects. For making separation negatives from Kodachrome and other color transparencies, the narrower cutting tricolor set (Wratten Nos. 29, 61, 49) is recommended.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes. Cemented filters should be purchased in matched sets to assure accurate registration of the three film images.

**Filter Factors:** Based on an exposure of 60 seconds through the Wratten A Filter.

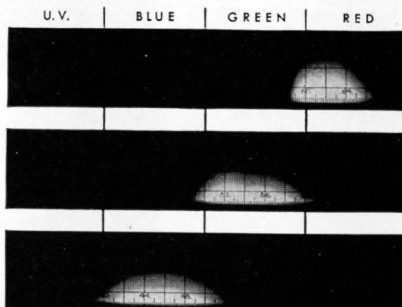
#### KODAK TRI-X PANCHROMATIC FILM

Filter	Sunlight	White Flame Arc (Anode in Lower Position)	Photoflood	High-Efficiency Tungsten
A (No. 25)	12	20	8	5
B (No. 58)	20	50	20	20
C5 (No. 47)	10	10	20	25

#### KODAK TRI-X PANCHROMATIC, TYPE B, PLATES.

A (No. 25)	16	20	8	6
B (No. 59)	16	25	16	16
C5 (No. 47)	6	8	12	16

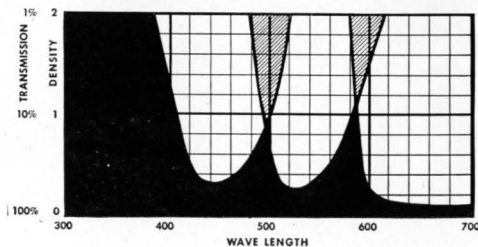
**Spectrograms** of Type B panchromatic film to tungsten light through Wratten A, B, and C5 Filters.



### Absorption Curves of Wratten A, B, and C5 Filters

The shaded areas indicate the overlap in transmissions of the various filters.

### 36 FILTERS



## Data—WRATTEN TRICOLOR FILTERS

### (For Color-Separation Negatives From Kodachrome Transparencies)

Filter	Number	Color
F	Wratten No. 29	Red
N	Wratten No. 61	Green
C4	Wratten No. 49	Blue

**Negative Materials:** Kodak Tri-X Panchromatic Film, Kodak Tri-X Panchromatic, Type B, Plates.

**Uses:** Matched set of narrow-cutting filters for making color-separation negatives from Kodachrome and other color transparencies.

**Available Forms:** Gelatin filter film, cemented in B glass, cemented in A glass, all common sizes. Gelatin recommended for separation negatives by projection. Cemented filters should be purchased in matched sets to assure accurate registration of the three images.

**Filter Factors:** Based on an exposure of 60 seconds through the Wratten A Filter.

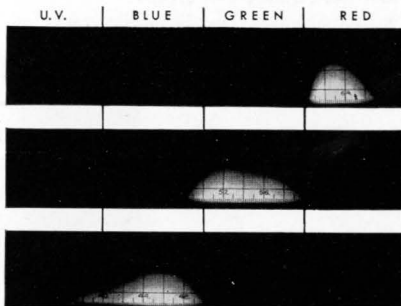
#### KODAK TRI-X PANCHROMATIC FILM

Filter	Sunlight	White Flame Arc (Anode in Lower Position)	Photoflood	High-Efficiency Tungsten
F (No. 29)	32	50	16	12
N (No. 61)	50	100	50	50
C4 (No. 49)	32	40	80	100

#### KODAK TRI-X PANCHROMATIC, TYPE B, PLATES.

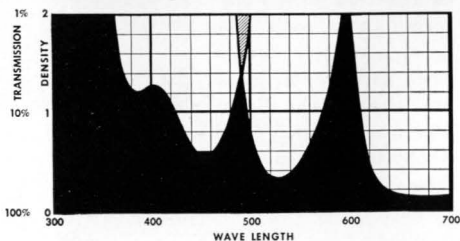
F (No. 29)	40	50	20	16
N (No. 61)	40	50	40	40
C4 (No. 49)	20	25	50	50

**Spectrograms** of Type B panchromatic film to tungsten light through Wratten Filters F, N, and C4.



### Absorption Curves of Wratten Filters F, N, and C4.

The shaded areas indicate the overlap in transmissions of the various filters.



# KODAK POLA-SCREENS

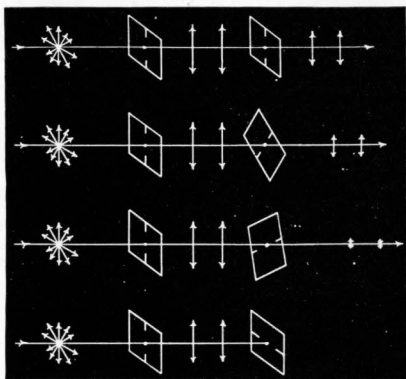
KODAK Pola-Screens offer a means of subduing undesirable reflections from nonmetallic surfaces. The Pola-Screen is rotated until the desired effect is observed, then placed over the camera lens. A Pola-Screen Viewer permits this adjustment to be made with the Pola-Screen on the lens.

Blue sky at right angles to the sun may be darkened as desired by means of a Pola-Screen, without distorting other subject colors. For maximum effect, it should be rotated so that its handle points directly toward the sun. Even more spectacular results on black-and-white film may be obtained by using a K2, X1, or "A" filter in conjunction with the Pola-Screen. An "A" filter sky effect can be secured on Verichrome Film by use of a Pola-Screen and K2 filter. With Kodachrome or Kodacolor Film, a Pola-Screen can be used to obtain a deep blue sky, an effective background for blossoms, trees, or buildings.

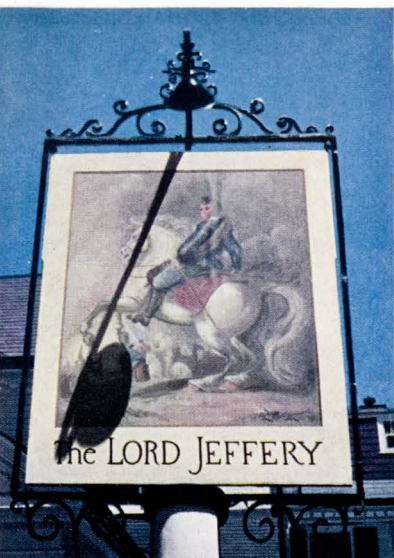
Kodak Pola-Screens require two times normal exposure with Kodak panchromatic films or color films, two and one-half times with Verichrome Film. For outdoor pictures, these exposure factors must be applied to a normal exposure for a *side-lighted* subject.

## How the Pola-Screen Works

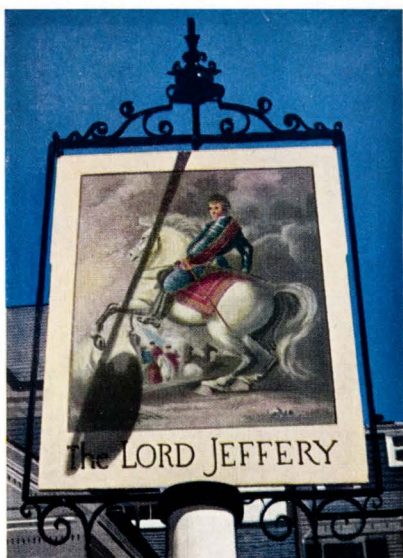
Ordinary unpolarized light vibrates in all planes perpendicular to the direction of its propagation; polarized light, in only one plane, as shown in Figure 8. The Pola-Screen is in effect an optical slit which transmits only light vibrating in the plane of that slit. The intensity of light already polarized can be controlled by rotation of a Pola-Screen in its path. The beam is entirely cut off when its vibration plane and that of the Pola-Screen are "crossed," and wholly transmitted when these vibration planes are parallel.



**Figure 8**—Effect of rotation of one Pola-Screen relative to another. The amount of light let through by the second Pola-Screen is cut down as the Pola-Screen is turned. When the vibration plane of the second Pola-Screen is at right angles to the first, practically no light gets through.



Taken at 1/50 second at f/5.6 without a Polar-Screen.



Taken through Kodak Polar-Screen with Indicator Handle toward the sun, 1/50, f/4.

*These two photographs taken on Kodachrome Film show the effect of the Kodak Polar-Screen in darkening a blue sky at right angles to the sun and in subduing reflections from nonmetallic surfaces. The subduing of specular reflections from colored objects results in greater purity of color.*

There are two common sources of polarized light in nature. (1) Light reflected at approximately  $35^\circ$  from nonmetallic surfaces, such as wood, glass, water, or paint, is polarized. The effect is less at other angles and disappears entirely at  $0^\circ$  and  $90^\circ$ . (2) Light from a clear, blue sky at right angles to the sun is strongly polarized; at other angles polarization is not complete and vanishes at  $0^\circ$  and  $180^\circ$  from the sun.

### **Copying and Reflection Control with Pola-Screens at Lens and Lights**

Complete control of reflections can be obtained in the studio by using a Kodak Lamp Pola-Screen (12 x 12-inch) over lamps and a Kodak Pola-Screen over the camera lens. Since the subject is illuminated by polarized light, the light reflected specularly from any surface is also polarized, and reflections can be controlled by rotating the Pola-Screen in front of the camera lens. By this means, reflections from any type of surface not necessarily oblique to the camera axis can be subdued to almost any degree.

## Data—KODAK POLA-SCREENS

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**Color:** Neutral gray. Transmits plane polarized light of all visible colors. Absorbs ultraviolet rays.

**Sensitive Materials:** Can be used with all sensitive materials, including Kodachrome and Kodacolor Films.

**Uses:** *Darkening the Sky in Black-and-White Photographs.*

A blue sky can be darkened to about the same extent as with an "A" filter without distorting the color rendering of the foreground.

*Dark Blue Sky Effects in Color Photography.*

Pola-Screens offer the only known means of sky brightness control in color photography.

*Photographing through Glass or Water.*

When the camera axis is about  $35^\circ$  to the surface, the Pola-Screen can subdue reflections from glass or water to show detail beyond or below.

*Subduing Oblique Reflections to Show Texture.*

Reflections from lights or light backgrounds can be subdued to show texture in non-metallic surfaces where the angle of reflection is about  $35^\circ$  to the surface. Reflection control on metal surfaces requires Pola-Screens at the lights as well as the lens.

*Reflection Control in Copying.*

The Pola-Screen at the lens alone has no application to copying. However, Pola-Screens can be placed over both the lens and the lights to achieve complete control over reflections from rough, matte, or damaged prints, from paintings, murals, and billboards, and from any objects having troublesome reflections. The Kodak Lamp Pola-Screen (12 x 12-inch) is supplied for use over lights.

**Exposure Factor:** With the Kodak Pola-Screens currently supplied, the exposure factor is 2 for panchromatic films and color films,  $2\frac{1}{2}$  for orthochromatic films (Verichrome). These factors are sufficient for average subjects. In some cases, fifty per cent more exposure may be necessary.

**Important:** Since the camera must point at right angles to the direct rays of the sun for the darkest sky effects, the subject will be lighted from the side or overhead, depending on the hour of the day. This affects the exposure required. For an average subject photographed through the Pola-Screen on Kodachrome Film, Daylight Type, a typical exposure for still cameras is  $1/50$  at  $f/2.8$  to  $f/4$ ; for motion-picture cameras,  $f/3.5$ . For Kodacolor Film, a typical exposure is  $1/50$  at  $f/5.6$ .

**Types of Pola-Screens:** *Kodak Pola-Screens* in all series for Kodak Combination Lens Attachments and in W mounts for Ciné-Kodak  $f/1.9$ , 1-inch lenses. Kodak Pola-Screens are suitable for use with both black-and-white and Kodachrome Film.

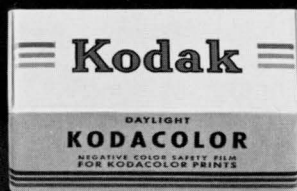
*Kodak Pola-Screens* in metal cells  $2\frac{1}{2}$ ,  $3\frac{1}{2}$ , and  $4\frac{1}{2}$  inches in diameter for use (with the Kodak Pola-Screen Holder of appropriate size) with lenses ranging from  $1\frac{3}{4}$  to  $5\frac{5}{8}$  inches in diameter. The Pola-Screens currently supplied in these sizes can be used for either black-and-white or color photography.

*Kodak Lamp Pola-Screens* (12 x 12-inch) are supplied in mounts for use over lights.

They are intended for black-and-white photography, but can be used with Type A or Type B Kodachrome Film and recommended light sources, if both a Pola-Screen and a Kodak CC33 Filter are placed over the camera lens.

**Kodak Pola-Screen Viewer:** The Kodak Pola-Screen Viewer is a miniature Pola-Screen mounted to slip onto the handle of Series V, VI, VII, and VIII Kodak Pola-Screens. In this position, its plane of polarization is parallel to that of the Pola-Screen. Thus, by examining the scene through the viewer, the degree of polarization can be judged visually without removing the Pola-Screen from the camera lens.

# KODACHROME AND KODACOLOR FILMS







# KODACHROME AND KODACOLOR FILMS

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THIRD EDITION, 1947



THUMB INDEX ➤

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# KODACHROME AND KODACOLOR FILMS

COLOR photography, an increasingly useful medium to the advanced amateur and professional photographer, is also well within the range of ability of the occasional picture taker. With Kodak color films—Kodachrome and Kodacolor—the photographer can, with little skill other than that needed for taking black-and-white snapshots, get pictures in full color. From box camera to precision miniature, there is a color film for all.

Kodachrome Film produces striking color transparencies for slides and prints and 8 or 16-mm. motion pictures. Kodacolor Film, made in the most popular roll-film sizes, provides color negatives from which attractive color prints on paper can be made.

The taking of pictures on color film gives the user a two-fold advantage—color photographs and the possibility of making, with simple darkroom technique, black-and-white prints from either Kodachrome transparencies or Kodacolor negatives.

The ease with which Kodak color films can be used has added to their popularity. No filters or extra attachments are required under ordinary picture-taking conditions if the film is used with the type of lighting for which it is intended. Following simple exposure requirements will produce good results for even the casual picture-taker.

Kodak's first color film was introduced in 1928. Since that time the public interest in color photography has heightened to such a degree that few photographers, amateur or professional, now rely alone on black-and-white picture taking. The taking of pictures in color has come of age as another easy-to-use photographic medium.

**Kodachrome Films** are supplied for miniature (35mm and Bantam) and sheet-film cameras and for 8 and 16mm motion-picture cameras. After being exposed, they are sent to one of the Kodachrome Processing Laboratories listed in the film instructions, where they are developed into full-color positive transparencies. Processing cost is included in the purchase price of the film.

Standard 35mm cameras produce 24 x 36-mm pictures on K135 Kodachrome Film, Kodak Bantam cameras 28 x 40-mm pictures on K828 Film. All processed K135 and K828 films, if exposed in standard cameras, are returned as Kodaslide in individual 2x2-inch mounts (unless the customer has given other instructions). These transparencies are ready for projection in a Kodaslide Projector. Projection data appears in the Kodak Data Book, *Slides*.

Color movies can be made on either 8 or 16mm Kodachrome Film. After being processed and returned to the customer, these films are ready for projection. Kodachrome Film in sheet form is called Kodachrome Professional Film. After processing, sheet Kodachrome transparencies are returned to the customer in protective viewing sleeves. Complete information about Kodachrome Professional Film appears in the Kodak Data Book, *Photography with Kodachrome Professional Film*.

**Kodachrome Prints** are made from 35mm and Bantam Kodachrome transparencies upon order through Kodak dealers. From sheet Kodachrome, Kodachrome Professional Prints are available.

**Kodacolor Roll Film** is supplied for roll-film cameras accepting C127, C120, C620, C116, and C616 films. Exposed Kodacolor Films are developed by the Eastman Kodak Company. From the resulting color negatives, Kodacolor Prints can be ordered through Kodak dealers. The cost of the film includes development, but does not include the making of Kodacolor Prints.

This Data Book, *Kodachrome and Kodacolor Films*, will answer most of the questions encountered in the use of these color films. The first section describes certain basic considerations in color photography—the types of film to be used in daylight and artificial light, and the lighting conditions and subject characteristics which the photographer must recognize in order to obtain well lighted, correctly exposed color photographs. The second major section is devoted to Kodachrome Film and associated products, and the third to Kodacolor Film and Kodacolor Prints. These sections provide detailed information about exposure and lighting technique, storage and care of the films, color prints and Kodachrome Duplicates, black-and-white prints, and other subjects.

# CONSIDERATIONS IN COLOR PHOTOGRAPHY

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Good color pictures with Kodachrome and Kodacolor Film are relatively simple to make and do not require a wide knowledge of photography. The user must, however, exercise care in several details if pleasing results are to be obtained. Modern black-and-white films have great exposure latitude; in addition, the wide range of contrasts in printing papers makes it possible to compensate for errors in exposure. Color films have limited exposure latitude and must therefore be exposed more carefully.

## **Light and Types of Film**

Kodachrome Films are manufactured in two forms—Daylight Type for use in daylight, Type A or Type B (sheet film) for use with artificial illumination. Kodacolor Film should, for best results, be used only when the subject is sunlit. Although filters can be used to permit the use of Daylight Type films with artificial light and Type A or Type B films with daylight, most satisfactory results will be obtained when each film is used with the type of illumination for which it is intended.

## **Subject Color**

Even though the color of an object is constant, its appearance changes when it is illuminated by different types of light sources or when it is placed in different surroundings. The average person does not notice these color variations in photographic subjects because the mental part of his vision adjusts itself for the changes. A color film has no such power for adjustment of illumination or color-of-surroundings differences. It must record the colors just as they are transmitted by light to the emulsion.

Just as one person may see the beautiful reflection of trees where another sees only the water of a stream, so are there those who have learned to “see” colors—not just the large masses of green or blue, but also the delicate shadings. Since color film overlooks nothing in its methodical recording of sufficiently lighted objects, those who take color pictures are sometimes surprised to find many eye-neglected colors on transparencies or prints. Subjects in the shade, illuminated by a clear blue sky, naturally are recorded bluish on color film. Color pictures of people taken by the light of an early morning or late evening sun reveal that sunlight is more orange at these times as it produces a warmer than normal rendering of flesh colors.

Another example of the color film “seeing” what the eye may neglect



occurs when the color of surroundings is reflected to the subject. A portrait of a person standing near a red brick building may reveal that red light was reflected to the subject from the building and recorded in the color picture. If part of the building shows in the picture, the person viewing it accepts the colors as natural. Green grass, bright clothing, etc., are often sources of such reflected light in portraits.

### **Lighting Contrast**

Since the brightness range that the color film will record is less than that of black-and-white film, the user of Kodachrome and Kodacolor Film should avoid subjects in which there are extreme highlights and deep shadows unless the pictures are taken for that effect. Good detail should not be expected in both the highlights and shadows when the lighting contrast is extreme. For pictures of people outdoors, the full lighting produced by sunlight coming over the shoulder of the photographer to strike the subject from the front will give the most satisfactory effect. Subject positions that produce side lighting and back lighting may give effective Kodachrome pictures if the camera side of the subject is well illuminated by open sky, or if reflectors are used to light the shaded areas. Exposure recommendations for such lightings must be followed closely. A white cloth, sheet of cardboard, or a projection screen are good reflectors for building up light in shaded areas when taking close-ups of people and pictures of flowers and other small objects. Kodacolor pictures require even more care in adding light to shaded areas when the subject position does not afford full front lighting.

For pleasing effects in nearly all outdoor photographs, it is necessary to give careful consideration to the position of the sun. Pictures of people made during the middle of the day with the sun directly overhead are not pleasing because of the heavy shadows under the eyes, nose, and chin of the subject. During midmorning and midafternoon, with the sun lower in the sky, excellent modeling and shadow effects are easily obtained. In some locations during winter, the sun is low enough in the sky during midday to afford good lighting. The angle of the sun is also important in making scenic and architectural photographs since their success depends largely upon shadows and texture.

Correctly exposed Kodachrome and Kodacolor pictures made under conditions of a hazy sun, with soft shadows cast, are usually quite good because of the soft lighting. Kodachrome pictures properly exposed on dull days, while somewhat bluish, are pleasing, which is usually not the case in black-and-white photography.

## Judging Subject Brightness

The subjects encountered in making color photographs range from very light in color to very dark, and reflect more or less light accordingly. The recommended exposures for Kodachrome and Kodacolor Film should be followed closely.

*Average Subjects*—Combination of light and dark subjects in about equal proportions. Ordinary family snapshots usually fall in this group with normal exposures required.

*Light Subjects*—Beach and snow scenes, light-colored flowers, people in white clothing, light-colored buildings and subjects of similar character. Light subjects should be given a half stop less exposure than would be needed for average.

*Dark Subjects*—Dark foliage, deep-colored flowers, dark animals, buildings and like subjects. A half stop more than the exposure for average subjects is required.

## Recognizing Lighting Conditions

There are several daylight conditions the photographer should learn to recognize in order to expose Kodachrome and Kodacolor Film correctly. Best results are obtained in daylight use of both Kodachrome and Kodacolor Film when the subject is lighted by either *bright* or *hazy sunlight*. Pictures taken under *cloudy* or *shade* conditions tend to be bluish. Instructions included with each roll of film, the Kodak dial-type guides, and the Data Sheets that follow in this text list exposure recommendations for the various light conditions.

## Color Harmony

Color harmony has been defined as the systematic arrangement of colors to give a pleasing effect. Whereas subject colors are of little importance in black-and-white photography, only their relative brightness being of interest, the pleasing effect of proper color arrangement should be considered in the taking of color pictures.

Most outdoor scenes have good color harmony, probably because the mind has grown to accept nature's color combinations as pleasing and harmonious. A little consideration given to the matter of color harmony in taking pictures other than those of nature, where changes may be effected, will improve many color shots.

Some outdoor subjects are rendered more striking when photographed against a darkened blue sky. Pink, orange, and yellow blossoms, autumn foliage, and some other subjects make spectacular pictures with such treatment. The sky can be darkened with a Kodak Pola-Screen without changing the color of other objects in the picture.



# KODACHROME FILM

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## Types of Film

Two films are available in both miniature and sheet-film sizes and for motion-picture cameras. For 35mm, Kodak Bantam, and 8 and 16mm motion-picture cameras:

*Kodachrome Film, Daylight Type*

*Kodachrome Film, Type A*

For sheet-film cameras:

*Kodachrome Professional Film, Daylight Type*

*Kodachrome Professional Film, Type B*

The Daylight Type films give the best color rendition of the subject in bright sunlight on a clear day, that is, in illumination which is the equivalent of noon sunlight plus skylight.

Kodachrome Film, Type A, is color balanced for use with Photo-flood Lamps having an approximate color temperature\* of 3400°K, and Kodachrome Professional Film, Type B, for 3200°K tungsten lamps.

Although it has been necessary to standardize on these readily available types of lighting, good color rendering can be obtained with certain other illuminants by means of the filters recommended in the Data Sheets.

## STORAGE BEFORE EXPOSURE

High temperature and high relative humidity accelerate the deterioration of all sensitized materials. If Kodachrome Film is subjected to either or both for long periods of time, unsatisfactory color rendition may result.

Since Kodachrome is supplied in two types of packages—domestic and tropical—it is important to know what protection is provided by such packages and what protection must be provided by users of the film. First of all, neither domestic nor tropical packing is heatproof. Secondly, when the seal of either type of packaging is broken, the protection originally provided is no longer effective.

**Domestic packing** is sufficiently moisture-resistant to protect Kodachrome Film under normal domestic conditions and in tropical regions that have climates not unlike those of the temperate zones.

**Tropical packing** provides extra protection for Kodachrome Film against moisture, plus protection against harmful gases. It is especially

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\*Color Temperature is the temperature, expressed in degrees Kelvin, to which a "black body" must be heated to emit light of the color required. Degrees Kelvin (°K) are 273° higher than the same temperature of the Centigrade scale, i. e., 3273°K is equal to 3000°C.

recommended for film that is to be taken for prolonged periods of time into regions having sustained high relative humidity.

### Storage Precautions Required with Domestic Packing Only

**1. Protection against moist air.** Film in domestic packing should not be stored unprotected in damp basements or in refrigerators containing food or liquids in open containers where the relative humidity cannot be controlled. If storage in such places is felt necessary for keeping the film cool, the film should first be placed in a can or jar that can be tightly closed.

If possible, film in domestic packing should be stored where the relative humidity of the storage chamber can be kept between 40 per cent and 60 per cent, preferably near 40 per cent. A high temperature with low relative humidity, e.g., 60°F with 40 per cent relative humidity, is better than a low temperature with high relative humidity, e.g., 40°F with 80 per cent relative humidity.

It is always advisable to check the relative humidity of the storage chamber by means of a wet-and-dry bulb thermometer.

**2. Protection against harmful gases.** Film in domestic packing must be kept away from formaldehyde, industrial gases, motor exhaust, and vapors of solvents and cleaners. Sealing the film in a can or jar will provide protection not provided by the package itself.

### Storage Precautions Required for Both Domestic and Tropical Packing

**1. Protection against heat.** Film must never be placed near steam pipes or other sources of heat, or left on top floors of uninsulated buildings or in automobile glove compartments. In the tropics, and during summer heat in temperate zones, refrigerated storage is recommended provided film is tropically packed, or if domestically packed it is first placed in a can or jar that can be tightly closed. Where possible, the following storage temperatures should be maintained:

For storage periods up to	2 months	6 months	12 months
Keep film below	75° F	60° F	50° F

Lower temperatures are desirable provided relative humidity does not exceed 60 per cent.

**Caution:** Film kept in cold storage should be removed several hours (preferably 24 hours) before packages are to be opened to avoid condensation on the cold film.

**2. Protection against x-rays.** In hospitals or industrial plants, film must be protected from x-rays and radium by lead-lined storage cabinets. Further information is available on request.

**3. Use before expiration.** If possible, Kodachrome Film should always be used before the expiration date stamped on each box. Film kept past this date may require one-half to one stop greater than normal exposure and color rendition may be unsatisfactory.

### **STORAGE AFTER EXPOSURE**

When film packages are opened, the film soon comes into moisture equilibrium with the air. If left in the camera under humid conditions, it may deteriorate rapidly. *Packages should not be opened in humid tropical regions until needed for use, and the film should then be exposed and sent for processing as quickly as possible.*

If several days or weeks are to elapse between exposure and processing, the film should be dried, resealed in the original package, and kept as cool as possible. Drying can be accomplished by storing the film in a can or jar with a desiccating agent such as silica gel, rice dried by browning in an oven, or dried tea leaves. The drying agent should be separated from the film by a porous partition. Two Davison Silica Gel Air Dryers, \* 4 ounces of silica gel, or two pounds of dried rice or tea leaves will dry ten 100-foot rolls of 16mm Kodachrome Film, while half these quantities will dry 20 rolls of 35mm and Bantam films.

The sealed package containing film and desiccating agent should be opened a day before the film is to be processed, to allow the film to absorb enough moisture to avoid trouble from static or brittleness.

## **EQUIPMENT FOR KODACHROME PHOTOGRAPHY**

### **Cameras and Adapters**

The Kodak Ektra, the world's most distinguished miniature camera, is not available at the present time but will soon be in production again. With its wide selection of fine Ektar Lenses, the Ektra gives a superb performance in both black-and-white and color photography with 35mm film.

In the moderately priced group of 35mm cameras is the Kodak 35 in four models. The "35's" are versatile miniatures with fast, color-corrected Luminized lenses, giving brilliant Kodachrome images.

Two Kodak Bantams, using 8-exposure K828 film, are recommended

for making color pictures—the Kodak Bantam Special with Ektar  $f/2$  Lens, and the Kodak Bantam  $f/4.5$ .

\*Davison Silica Gel Air Dryers are available from many photographic dealers, and from The Davison Chemical Corporation, Baltimore 3, Maryland, U. S. A.

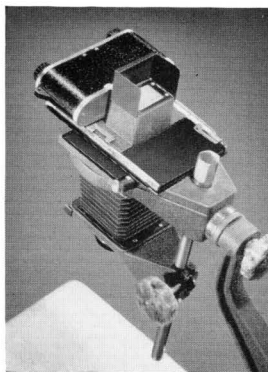
**The popular Kodak 35,  $f/3.5$ ,  
with Range Finder.**



Several models of Ciné-Kodaks are available for the amateur and professional movie maker; more are on the way. All are of time-proven quality and produce excellent color movies.

**Bantam and 35mm Kodachrome Adapters:** These adapters make it possible to use miniature-camera films with a Kodak Recomar 18 or 33, with a Camera Back Adapter for the Kodak Precision Enlarger, and with most other cameras which will take the Kodak Combination Film and Plate Holder. The adapters virtually convert these larger cameras to miniature cameras with long-focus lenses. They can be used for many types of special work, being ideal for flower and nature photography, miniature portraits, copying, Kodachrome photomicrography, and telephoto work.

Each Kodachrome Adapter consists of a camera back and a hooded ground glass focusing panel. These two items are mounted side by side in a sliding plate, so that either will slide into the image position. The entire unit is attached to the camera in the same manner as a film pack adapter.



**35mm Kodachrome Adapter A  
on Precision Enlarger**

### **Filters for Kodachrome Photography**

The color filters commonly used in black-and-white photography cannot be used with Kodachrome Film. If one of these filters is used, the pictures will show an over-all cast of the same color as the filter. The filters below are for special purposes in Kodachrome photography.

*The Kodachrome Haze Filter (Wratten No. 1)* is a colorless filter which absorbs all ultraviolet rays of shorter wave length than  $380\text{ m}\mu$ . It is used with Daylight Type films for pictures which might otherwise show excessive bluishness. Examples are distant mountain views which show bluish haze, high-altitude aerial pictures, and outdoor scenes under an overcast sky or in shade illuminated by blue sky. The color rendition obtained with this filter is slightly warmer than that obtained with no filter. When the No. 1 filter does not sufficiently reduce bluishness in certain unusual subjects, the *Wratten Filter No. 2A* can be used for still warmer results. Neither of these filters requires an increase in exposure. The No. 2A filter is also recommended when Kodachrome

Professional Film, Type B, is exposed by means of Photoflash Lamps, such as Mazda Nos. 5, 11, 22, and 50.

*The Kodachrome Type A Filter for Daylight (Wratten No. 85)* is orange in color and must be used if Type A Kodachrome is to be exposed in daylight. Sunlit pictures taken in this manner may be quite satisfactory. However, the Type A film and Type A filter combination is not recommended for general daylight use because: (1) With some subjects, and especially under overcast conditions, this combination does not produce as good color rendering as Daylight Type film with no filter; (2) the Kodachrome Type A Filter is only moderately stable and may fade, particularly if subjected to sunlight for long periods.

For scenic photographs taken at high altitudes under hazy conditions, Type A film with the Kodachrome Type A Filter for Daylight affords somewhat better rendition of color and distant objects than Daylight Type film with the Kodachrome Haze Filter. Because the Type A filter absorbs ultraviolet radiation, the Haze filter is never required in addition to the Type A filter.

*The Kodachrome Filter for Photoflood (Wratten No. 80)* is bluish in color and must be used if Daylight Type Kodachrome is to be exposed by Photoflood illumination. This is suggested for emergency use only, because it requires four times as much exposure as Type A film with Photoflood Lamps, and because the color rendition is not as good.

*The Kodachrome Type B Filter for Daylight (Wratten No. 85B)* is orange in color and permits the exposure of Kodachrome Professional Film, Type B, in daylight. This combination requires about one-third stop more exposure than Kodachrome Professional Film, Daylight Type, and is not recommended for best color rendering of outdoor subjects.

*The Kodak Color Compensating Filters* are recommended for special purposes in Kodachrome photography, as noted in the Data Sheets. Made in three concentrations of yellow, magenta, and cyan, these filters are designed to absorb different amounts of the three primary colors—blue, green, and red. They can be used singly or in combination with themselves or other filters for slight color corrections.

### **Kodak Pola-Screens**

In Kodachrome photography, Pola-Screens are used to darken blue skies and to subdue non-metallic reflections; they require one stop greater than normal exposure. Kodak Pola-Screens are supplied in all series of Kodak Combination Lens Attachments, in W mounts for Ciné-Kodak 25-mm.,  $f/1.9$ , Lenses, and in metal cells  $2\frac{1}{2}$ ,  $3\frac{1}{2}$ , and  $4\frac{1}{2}$  inches in diameter for use (with the Kodak Pola-Screen Holder of

appropriate size) with lenses having diameters from  $1\frac{3}{4}$  to  $5\frac{5}{8}$  inches. For more complete data, see the Kodak Data Book *Filters and Pola-Screens*.

### **Exposure Guides**

For Kodachrome photography under all but the most unusual lighting conditions, the following simple exposure guides are recommended:

*Snapshot Kodaguide*—Provides a quick method of determining proper still camera settings outdoors and indoors for Kodachrome and Kodak black-and-white films, and outdoors for Kodacolor Films. Includes illustrations of types of picture subjects encountered, hints on taking pictures, and a lighting diagram for indoor pictures. Pocket size.

*Flash Kodaguide*—Supplies data for determining the correct lens opening for various Photoflash Lamp and shutter speed combinations when using Kodak black-and-white and color films. Includes Exposure Guide Numbers, plus helpful suggestions for both indoor and outdoor flash-type pictures. Pocket size.

*Movie Kodaguide*—Provides an easy method of calculating correct camera settings for the exposure of Ciné-Kodak black-and-white films and Kodachrome Film outdoors in daylight or indoors by Photoflood Lamps. Pocket size.

*Ciné-Kodak Universal Guide*—A metal, dial-type exposure calculator attached to Ciné-Kodaks (See illustration on page 19). Exposure cards, supplied with Ciné-Kodak Film, are inserted in the guide so that exposures can be calculated for the particular film being used. The guide is also available as an accessory for pocket use.

### **Lighting Equipment**

**Lamps.** For use with Kodachrome Film, Type A—Photoflood Lamps Nos. 1 and 2, and Reflector Photoflood RFL2; Photoflash Lamps SM and Nos. 5, 6, 11, 22 and 31.

For use with Kodachrome Film, Daylight Type—Daylight Photoflood Lamps Nos. B1 and B2; Photoflash Lamps (primarily intended as supplementary to daylight) Nos. 5B and 22B.

Best color rendering with Photoflash Lamps requires the use of the filters recommended in the Data Sheets for Kodachrome Films.

**Lighting Units.** The Kodaflector and the Kodaflector Senior each have two conical reflectors on stands. With Photoflood Lamps Nos. 1 or 2, these units provide excellent illumination for indoor pictures.

**Flash Synchronizers.** The Kodak Flashholder for use with Flash Supermatic Shutter and the Kodak Junior Synchronizer for use with non-synchronized shutters, are suitable for making Kodachrome pictures with Photoflash Lamps.



A pretty girl and spring blossoms called for this eye-appealing Kodachrome close-up.

## TAKING KODACHROME PICTURES IN DAYLIGHT

SUCCESS in Kodachrome photography depends largely upon the accuracy of exposure. For best possible results, exposure should be correct to within half a stop. Thus camera settings must be determined much more carefully than in black-and-white photography.

**Correctly exposed** Kodachrome transparencies, when properly projected or viewed on a suitable illuminator, are neither too light nor too dark. All colors are fully represented, unless the subject was too contrasty to record properly.

**Underexposed** Kodachrome appears too dark, or even black.

**Overexposed** Kodachrome is too light. The colors appear washed out. Because Kodachrome is a reversal process, the greater the exposure, the lighter is the finished picture.

**Subjects often wrongly exposed are:** Subjects against the light (commonly underexposed), open beach scenes (commonly overexposed), and scenes in the woods (frequently underexposed). Partially sunlit scenes in the woods are often difficult to photograph because of the great difference in brightness between the areas of sunlight and shade. In this and other cases of extreme brightness range, the exposure should be adjusted to favor the more important areas.

### EXPOSURE DATA

Complete exposure information appears in the Data Sheets. Other sources of exposure data are the instructions supplied with the films, the Ciné-Kodak Universal Guide (supplied with Ciné-Kodaks), and the popular Snapshot Kodaguide, a dial-type exposure guide previously described.

Kodak exposure recommendations are constantly checked by exhaustive photographic tests, and the tables and guides in which these recommendations appear have been thoroughly tested against other methods of exposure determination. For the lighting conditions and subject types to which they apply, the tables and guides can be depended upon to yield good pictures.

### USING AN EXPOSURE METER OUTDOORS

Photoelectric exposure meters can be of real help to the skilled worker, especially for unusual lighting conditions. The meter must be calibrated properly and used correctly in accordance with the manufacturer's instructions. In daylight, certain meters should be pointed downward to minimize the effect from the sky; this will be indicated by the instructions supplied with the meter. In artificial light, the settings recom-



mended in Kodak publications will apply if the meter reading is taken from the camera position, and if the subject has average reflectance.

Meter readings on outdoor subjects that indicate lens settings of less than  $f/11$  for an amateur motion-picture camera, or exposures of less than  $1/50$  second at  $f/8$  with a 35mm or Bantam still camera, should be disregarded because underexposure is likely to result.

If good results are not being obtained with a meter, even though directions for its use are being strictly followed, the meter-camera combination should be checked by test exposures. By taking readings of many ordinary scenes and comparing the values the meter gives with the film exposure tables, a tentative meter setting can be selected. Test exposures can then be made at the setting suggested by the meter, at one stop more, and at one stop less. This should be done for several different subjects, and the processed transparencies compared carefully to determine the best meter setting.

Exposure index values, recommended as settings for meters using ASA Exposure Indexes, will be found in the Data Sheets. For the various makes of meters calibrated in Scheiner and DIN scales, different settings are required. The Scheiner settings for Daylight Type Kodachrome range between  $17^\circ$  and  $25^\circ$ , while meters calibrated in DIN frequently require  $14/10^\circ$ . In general it is well to choose a tentative setting, and make test exposures as explained above.

## **EXPOSURE OF KODACHROME FILM FOR SPECIAL SUBJECTS**

Exposure tables supplied with Kodachrome Film and information in the Kodaguides mentioned are adequate to assure good exposure for the subjects generally photographed. However, there are many subjects which require special exposure information. Those which occur most frequently are treated in the following paragraphs. *The data given are for exposures with Kodachrome Film, Daylight Type.*

### **Ciné Titles**

With Kodachrome Film, Daylight Type (16mm and 8mm) movie titles in color can be made as easily as black-and-white. White title cards in full sunlight require an exposure of  $f/11$ ; colored cards require  $f/8$  to  $f/11$ .

Titles can also be made easily with Kodachrome Film, Type A, and a Photoflood Lamp with the Ciné-Kodak Titler.

### **Synchronized Flash Photography Outdoors**

Photoflash Lamps Nos. 5B and 22B can be used outdoors in synchronizers to illuminate shadows or to supplement poor natural light such as that on cloudy days. (See Data Sheets for Daylight Type films.)

## Flowers

Gardens or groups of flowers are treated as any normal outdoor subject in sunlight, and an exposure between  $f/5.6$  and  $f/8$  at  $1/50$  second is suggested. Close-ups of single blooms or clusters often require higher shutter speeds to stop the motion caused by light breezes;  $1/100$  at  $f/4$  is suggested, although in making flower close-ups the depth of field required sometimes demands a small lens opening. In such cases the photographer must wait for the flower to become still and expose longer. With motion pictures, a slight wind motion is very desirable. Side lighting or back lighting to bring out the texture requires increased exposure unless a large white reflector is used to lighten the shadow side. If there is a patch of sunlight near a shaded subject, a crumpled tinfoil reflector can be used to reflect additional light on the subject and partly counteract the greenish light in the woods. A gray or colored cardboard background, large enough to fill the picture area, can be used to isolate single flowers.

For close-ups beyond the range of ordinary cameras, Portra Lenses are recommended. Such lenses are available for both still and motion-picture cameras.

## Architectural Interiors by Daylight

These subjects require time exposures with the camera on a tripod. Because of the great variation in illumination, the exposure range method is suggested, for example, exposures of 15, 30, and 60 seconds at  $f/16$ . It is usually difficult to light a room with sufficient uniformity by daylight alone. Daylight (blue-bulb) Photoflood Lamps are recommended to light the darker areas. If regular tungsten or Photoflood Lamps are added, the resulting Kodachrome transparencies will be yellowish in the parts so lighted.

## Subjects Indoors Near Windows

The subject should be about three or four feet from a large window which receives direct light from the open sky. The camera should view the subject from a position close to the window. If the subject is *not* in direct sunlight, the usual lens aperture for motion-picture cameras is  $f/2.8$  or  $f/1.9$ ; if the sun is shining on the subject,  $f/5.6$  or  $f/8$ . For still pictures these same apertures apply at  $1/25$  second.

Reflectors should be used to increase the illumination in the shadows. A projection screen, white cloth, or large mirror can be used as a reflector; it should be positioned carefully to lighten the principal shadows in the subject. If the window is behind the camera, there will be fewer shadows, and a reflector will not be necessary.

## Sunsets

Sunsets are photographed most effectively when the sun is partly or wholly obscured by a cloud. An unobscured bright sun may cause flare spots. Suggested camera setting:  $f/4$  and  $1/50$  second. Less exposure makes the sunset appear further advanced; more exposure makes it appear as if it were at an earlier stage. The afterglow immediately following a sunset may require  $1/25$  to  $1/10$  second at  $f/2$ . Motion pictures of sunsets in Kodachrome may be made at normal speed and a lens opening of  $f/5.6$ .

## Winter Scenes and Beach Scenes

At first thought it might seem that a color picture of a winter landscape might be no more attractive and realistic than a black-and-white picture of the same scene. Actually, however, there are a great many colors in the average winter landscape, and Kodachrome pictures of snow scenes are particularly pleasing. Snow scenes and beach scenes should be exposed as light-colored subjects.

Pictures of skiers and other subjects in open snow fields, and of people on open sandy beaches, require little or no increase in exposure for side lighting and back lighting. In such scenes, the shadow areas are usually small and well illuminated by sunlight reflected from the snow or sand. Open winter scenes *without snow* usually require about one stop more exposure than is normally recommended.

## Tropical Scenes

There are two extremes of prevailing tropical weather conditions, and these require a slight difference in exposure:

1. In many tropical areas, such as the West Indies, the air is almost continually hazy, but this haze appears to be neutral in color and its effect on Kodachrome is neutral. The haze is actually helpful in making Kodachrome pictures, because it diffuses sunlight, softens shadows, and thus lowers the contrast range of the scene.

For this type of hazy-day picture with Daylight Type Kodachrome Films, the exposure required is  $1/50$  second at between  $f/4$  and  $f/5.6$  for average-colored subjects; for light-colored subjects, beach, marine, and distant views,  $1/50$  second at  $f/5.6$ . Kodachrome movies at normal speed require  $f/5.6$  for the first mentioned subjects and one-half stop less for the second. On very hazy days, the diffusion is so complete that no exposure allowance is needed for side or back lighting.

2. The second tropical weather condition is the one encountered in such areas as the southwest United States and central Mexico, where

the atmosphere is often extremely clear and the range of light intensities on outdoor subjects very great. The lighting contrast may be so great that if the exposure be calculated for the brightest parts of the scene, the shadow areas will be rendered very dark. The best pictures under these conditions are those made with full front lighting so as to have relatively few shadow areas. Pictures of people taken at midday with the sun directly overhead should be avoided because of the shadows cast under eyes, nose, and chin. The exposure for such subjects, which are usually very light in color, is 1/50 second at  $f/8$  for K135 and K828. Eight and 16mm Kodachrome Films, Daylight Type, require an aperture halfway between  $f/8$  and  $f/11$  at normal camera speed. If the shadow areas are large and important, as is the case with some side-lighted subjects, the exposure must be *doubled* and some of the highlight detail sacrificed. If the subject is back-lighted and the highlight details unimportant, the scene should receive four times as much light as the same scene in flat sunlight. In this instance, the shadow regions alone will receive correct exposure and there is no need to give a compromise exposure for both highlights and shadows.

Offering utmost ease in operation, the Magazine Ciné-Kodak 16mm is ideal for "shooting" Kodachrome movies. Note the Ciné-Kodak Universal Guide, used with all Ciné-Kodak Films.



## KODACHROME PICTURES BY ARTIFICIAL LIGHT

THE TYPES of artificial light that are especially suitable for Kodachrome photography are described below. Exposure data is given in the Data Sheets, and with the lighting illustrations on pages 23, 24, 25, and 26. Ordinary home lighting lamps have little value in color photography because of their low illumination level and yellowish light.

**Photoflood Lamps** permit the exposure of Kodachrome Film, Type A, without filters. Photoflood Reflector Lamps are especially convenient to use since they require no additional reflectors. These and the regular No. 2 lamps give twice the light and have double the life of the No. 1 lamps. Daylight Photoflood Lamps can be used with Kodachrome Film, Daylight Type, when an indoor subject illuminated by daylight requires supplementary lighting. When these lamps are used for pictures of people, or independently of daylight, results are warm in hue. An exposure table for the use of Daylight Photoflood Lamps appears in the Data Sheet for Kodachrome Professional Film, Daylight Type.

*Note:* Not more than six No. 1 Photoflood Lamps or three No. 2's should be used on a single fused circuit as any load in excess of this number will probably blow fuses or damage wiring. With two 15-ampere circuits in a room, two No. 2 lamps can be used on each. It should be remembered that the main house fuse is usually for 30 amperes, so the total load must not exceed this amperage.

**Photoflash Lamps** provide plenty of light for the short exposures required in making pictures of children, other active subjects, and large groups. Filter recommendations and exposure data for Photoflash Lamps appear in the Data Sheets. Photoflash Lamps which can be used on regular house current for open-flash pictures are the Nos. 22 and 50. The SM and Nos. 5 and 11 Photoflash Lamps can be used in the Kodak Flashholder or in synchronizers. The Nos. 6 and 31 are long-peak lamps designed for use with focal-plane synchronizers.

*Caution:* Under certain conditions, the glass bulbs may crack or shatter when flashed. Therefore, it is recommended that a transparent plastic protective screen be used over the front of the Photoflash reflector. Do not flash in an explosive atmosphere.

**3200°K. Lamps** have the proper color temperature for use in exposing Kodachrome Professional Film, Type B. The 3200°K Mazda Lamps are supplied in stock voltage ratings of 115, 120, and 125 and should be operated at the rated voltage. Of these, the one best suited for home use is the PS-25, 500-watt, lamp, the size and base of which are the same as the Photoflood Lamp No. 2, and which is thus readily usable in most lighting equipment.

## Using An Exposure Meter

When using a reflected-light type exposure meter in connection with exposure indexes, best results can usually be obtained by taking meter readings of the light reflected from a gray or white card of known reflectance substituted for the subject matter to be photographed, instead of taking readings at the camera position. This is especially true of a composition or lighting arrangement that is unusual or complicated.

If readings are taken from a gray card having a known reflectance of 18 per cent, the exposure indexes furnished in the Film Data Sheets for use with artificial light can generally be used without adjustment.

If a white card, such as the back of clean, white, double-weight, photographic paper (reflectance about 90 per cent) is used instead of a gray card having 18 per cent reflectance, the light reflected will be about five times as great. The meter readings or the exposure indexes will therefore have to be divided by five. In the latter case, the resulting values can be rounded to the nearest figures on the exposure meter calculator. For example, the tungsten exposure index for Kodachrome Film, Type A, is 16. This value divided by five is 3.2. The figure on the meter calculator that should be used is 3.

As stated in the section *Taking Kodachrome Pictures in Daylight*, if results indicate the need or if the Kodachrome setting is unknown for the make of meter concerned, the best method of determining the correct combination of meter and camera is to make test exposures with the photographer's own equipment.

Distant subjects that are spotlighted, such as those on a stage or skating rink, can often be photographed with Kodachrome Film, Type A, even though there is not enough light to register on an exposure meter. Suggested exposures for such shots appear on page 27.

## Obtaining Proper Subject Contrast Indoors

Lighting contrast for Kodachrome should be considerably softer than that used in black-and-white photography, except where special effects are sought. This can be achieved by having the light intensity about equal over the entire set. This does not limit the photographer to flat lighting, but means that with color differences already affording separation between parts of the subject, he can use less contrast than for black-and-white work. The intensity of the highlight illumination should not exceed that of the shadow illumination by a ratio of more than 2 to 1, or, occasionally, 3 to 1. Auxiliary lamps to light backgrounds are particularly helpful in getting even over-all illumination.

A photoelectric meter can be used to secure proper subject contrast by exploring the scene to determine the brightness of its various parts. The Weston Electrical Instrument Corporation suggests that, when their meter is used, the readings should fall between the "A" and "C" arrows, which means a ratio of 4:1 to obtain proper exposure tolerance. This figure does not represent film latitude.

### **Clothing and Background Color**

The color of background, clothing, and other properties used when taking indoor Kodachrome pictures is usually within control of the photographer. Care in the selection of these items will result in more pleasing shots. The following suggestions may be helpful.

The color of clothing and background must be subordinate to the subject's face. The background color should be enough lighter or darker than the face to afford contrast, but it should not be so much lighter or darker that it will not photograph properly. Dark subjects are usually best presented against a lighter background, and lighter subjects against a darker one. A background having a color complementary to the principal color of the subject can be quite effective.

<b>Selection of Clothing and Background Color</b>		
<b>COLOR OF CLOTHES</b>	Light, soft colors are most effective and should be chosen to harmonize with complexion and hair color. Avoid dark colors or black. Also avoid brilliant colors which take attention away from the face.	
<b>BACKGROUND</b>	Use light buff or gray when in doubt. Other suggested colors are:	
	<b>CLOTHING COLOR</b>	<b>BACKGROUND COLOR</b>
<b>CHILDREN</b>	Light colors	White or very light tints
<b>WOMEN</b>	Pink Blue Yellow Green Maroon Gray Lavender White	Gray blue, jade green Yellow, darker blue Gray blue Darker green, lavender, gray Gray blue Dull blue Gray green Any light color harmonizing with subject's hair
<b>MEN</b>	Brown Tan Gray Blue White  Khaki	Buff or olive green Buff or olive green Dull blue Gray or buff Any light color harmonizing with subject's hair Dark green

FOR GROUP PICTURES...

## THIS 2-LAMP ARRANGEMENT

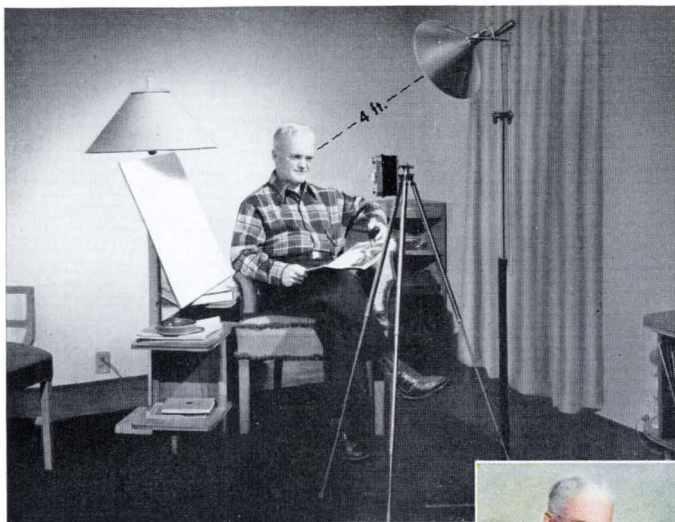


*Exposure Data for Type A film: 1/5 second, between  $f/4$  and  $f/5.6$ , with two No. 2 Photofloods in Kodaflectors (matte side) at 7 feet. For open flash, one No. 22 Photoflash Lamp in reflector at 9 feet,  $f/16$  with CC15 filter.*

Informal groups can be photographed effectively with two Photoflood Lamps. For such shots, place both lamps near to, but above, the camera axis and pointed down slightly. This lighting provides even illumination for a large area, but gives little modeling. If clothing and background colors are predominantly light (for example, a group of people dressed in white clothing near a light-colored wall), give one-half stop less than normal exposure. When dark clothing and dark background are predominant, give one-half stop more exposure than normal. Additional information on the use of Photoflood and Photoflash Lamps appears in the Data Sheets.



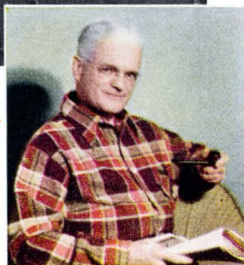
## A SINGLE LAMP AND REFLECTOR . . .



### FOR THIS PICTURE



*Data for Type A film: 1/10 second at f/4 or f/4.5, with one No. 2 Photoflood in Kodaflector (matte side) at 4 feet.*



A Reflector Photoflood can be used instead of a No. 2 Photoflood in Kodaflector. A reflector, such as a white matte card, is also required. Place the lamp slightly above and to one side of the camera. This position provides nearly full front lighting with slight shadowing for roundness in portraits and casts the subject shadow out of important picture areas. Place the reflector just outside the picture area and at the angle which reflects the maximum amount of light into the shadowed areas of the face. Direct the lamp at the reflector rather than at the subject. Place the subject close to a light-colored background, as dark backgrounds are usually unattractive in informal color portraits. The floor lamp shown in the black-and-white illustration was used to support the reflector, not as a light source, in taking this Kodachrome picture.

## CAMERA LIGHT AND SIDE LIGHT...



### FOR THIS PLEASING RESULT →

*Exposure Data for Type A film: 1/10 second, between f/4 and f/5.6, with two Reflector Photoflood Lamps at 5 feet.*

Two No. 2 Photofloods in Kodaflectors (matte side) can be used instead of Reflector Photofloods. The two lamps, placed as shown in the illustration, provide an effective basic lighting for most indoor portraits. Place one lamp at the camera near lens level, another as a side or modeling light above lens level. Arrange the side light so that it casts a triangular area of light on the cheek of the subject opposite the lamp. Place the subject close to a light-colored background if the background is not to be lighted independently. The above Photoflood arrangement gives a 2:1 lighting ratio, which is recommended unless special effects are desired. In the use of Photoflood Lamps, it is important that the lamps be arranged so that direct rays of the light do not strike the camera lens. The use of a lens hood is recommended.



FOR BETTER CLOSE-UPS . . .

## LIGHT THE BACKGROUND



*Data for Type A film: 1/10 second, between f/4.5 and f/5.6, with one Reflector Photoflood as camera light at 5 feet and another as side light at 4 feet. Two No. 1 Photofloods in clamp-on reflectors to light background.*

No. 2 Photoflood Lamps in Kodaflectors (matte side) can be used instead of the Reflector Photofloods. For pleasing close-ups in Kodachrome portraiture, special background lighting is usually required to produce separation of tone between the subject and the background. Place the camera light near lens level to provide general illumination and arrange the side light to cast a triangular pattern of light on the cheek of subject opposite the lamp. Direct the background lights so that they give even lighting to background, which should be four to six feet back of subject. Do not use too many Photofloods on any one circuit (see note, page 20).

## Exteriors at Night

The exposures suggested for the following exteriors at night are for Kodachrome Film, Type A. With Kodachrome Professional Film, Type B, the exposures given for still pictures with Type A film should be increased about 60 per cent. For exposures longer than 1/25 second, a camera support should be used. The Kodak Eye-Level Tripod, Kodak Turn-Tilt Tripod Head, Kodak Table Top Tripod, and Kodak Tilt-a-pod are useful accessories for such picture-taking activities.

**Brightly lighted streets** photograph best when wet, the reflection of the lights adding to the effectiveness and over-all illumination of the scene. Exposures which show street signs and street lights to best advantage are 1/10 to 1/2 second at  $f/2$ .

**Floodlighted buildings** require 1/10, 1/5, or 1/2 second at  $f/2$ .

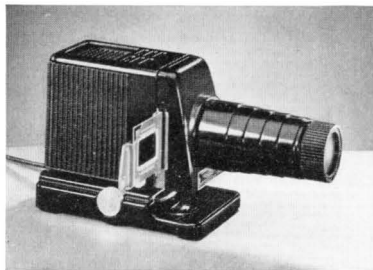
**Store windows**, if brightly lighted, require about the same exposure range as floodlighted buildings, 1/10 second at  $f/2$ .

**Fireworks** require opening the shutter with the diaphragm at  $f/5.6$  or  $f/8$  and leaving it open until the desired number of displays have been recorded. Several displays recorded on one film make interesting patterns. A tripod should be used.

Kodachrome movies can be made at  $f/1.9$ , normal speed, of practically all displays. For close-ups of white fire such as is used for the "Niagara Falls" display, the lens may be stopped down to  $f/2.8$ .

## Scenes on the Stage

The most suitable seat in the theater is one at such a distance from the stage that normal lens equipment will include the full width of the stage, or less, on the film area. Exposures for a brilliantly lighted stage are 1/20 to 1/10 second at  $f/2$  on Kodachrome Film, Type A. A quiet moment in the action must be chosen. Motion pictures at  $f/1.9$ , normal speed, can also be taken of brilliantly lighted stage action on Type A film. However, permission from the theater should be obtained before making such pictures.



For brilliant screen images from miniature Kodachrome transparencies, the Kodaslide Projector, Model 2A.

## SHOWING AND KEEPING KODACHROME PICTURES

MINIATURE transparencies can be viewed as they are or in small diffuse-light hand viewers, but only on projection are their true beauty, realism, and illusion of depth revealed. When colored slides are shown to friends, community groups, etc., they should be arranged for continuity and dramatic effect. The operator of the projector should be thoroughly familiar with its operation and can avoid later delay and confusion by setting up the projector and arranging for room light control before starting the show.

Motion pictures, to be most effective, should be properly edited and titled. As in the projection of slides, the operator should have a thorough knowledge of the operation of the projector and have all equipment set up and tested before the show is to begin. Easy control of room lights should be arranged beforehand. Background music from records, appropriate to the mood of the scenes being shown, adds a professional touch to both slide and motion-picture shows.

It is very important in projecting both slides and motion pictures that the screen image be small enough to retain its full brilliance, especially when there is stray light in the room. The audience should be seated between the projector and screen and near the projection axis.

**Projectors** recommended for both Kodaslide transparencies and 2 x 2-inch glass-bound slides include the Kodaslide Projector, Model 1, equipped with a 4-inch Lumenized lens, and the Kodaslide Projector, Model 2A, equipped with a 5-inch,  $f/3.5$  Lumenized lens. The 2A Model can also be used with a  $7\frac{1}{2}$ -inch lens.

For the projection of Kodachrome motion pictures Kodascope Eight-33 and Kodascope Sixteen-20 are recommended.

**Materials for mounting** Kodachrome transparencies between glass are included in the *Kodak Slide Kit* which contains binding accessories for 50 slides. Items in the kit can be purchased separately. Kodak Ready-Mounts made of cardboard are also available.

**Slide storage files** include the *Kodaslide Sequence File* (wood) and the *Kodaslide File Box* (metal). These boxes hold 140 to 150 Kodaslide or 48 to 56 glass-bound 2 x 2-inch slides, respectively. They are recommended for filing and storing small collections and are useful for transporting slides removed from larger files for a lecture.

### Storage and Projection

Many improvements have been made in the stability of Kodachrome dyes. We believe, but do not guarantee, that a life of many years can be expected for pictures made on present Kodachrome Film, provided

reasonable precautions are taken. All dyes are fugitive to some extent. The primary factors affecting their life are moisture, heat, and light.

**In storage,** film should be kept cool and dry, below 70° F and 50 per cent relative humidity. Warm attics and damp basements should be avoided. Kodachrome Film should never be purposely humidified. Ideal conditions, for maximum life, involve storing the film in a sealed, lighttight, desiccated container at 40° F or lower. Motion-picture films, however, should not be dried below 20 per cent relative humidity, because the film may become brittle and therefore break readily.

**In projection,** heat and light from the projection lamp tend to accelerate fading. With well-designed slide projectors, fading of slides is imperceptible for ordinary projection times of 30 seconds to 2 minutes. Longer times should be avoided. The heat-absorbing glass in the projector should never be removed, and a projection lamp of higher than recommended wattage should not be used.

The Underwriters' Laboratories, Inc., sponsored by the National Board of Fire Underwriters, describe Kodak Safety Film under the following classification: "Film, Slow burning—Hazards somewhat less than would be presented by common newsprint paper in the same form and quantity."

### **Cleaning and Waxing Motion-Picture Film**

By slowly drawing motion-picture film through a cotton pad moistened with a 0.1 per cent solution of carnauba wax in Kodak Film Cleaner,\* cleaning and waxing can be performed in one operation. The operation should be carried out slowly as the film is rewound to permit the film to dry before it reaches the reel.

### **Cleaning Miniature Kodachrome Transparencies**

In many cases, light fingerprints or oily smudges can be removed by breathing on the transparency, then wiping it gently with a soft cloth. If this is not successful, Kodak Film Cleaner\* can be used sparingly on a plush pad or a wad of cotton. However, the pad or cotton should be *only slightly moistened* so that no pools or droplets of liquid will be formed on the surface of the film. The moistened pad should be used with light, even strokes.

The use of too much cleaning fluid may cause streaks or spots by removing some of the protective lacquer with which the emulsion side of the film is coated. If this occurs, the lacquer should be removed completely, and Kodak Film Lacquer applied as described on next page.

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\*Fumes of this cleaner are toxic if inhaled. *Use sparingly in a well-ventilated room.*



## Removal of Lacquer From Transparencies

The protective lacquer can be removed from miniature Kodachrome transparencies by one of two methods, depending on the particular type of lacquer that has been used. The lacquers used on 35mm and Bantam Kodachrome Film have been of two types, one soluble in Kodak Film Cleaner, the other soluble in an alkaline solution (such as 5 per cent sodium carbonate or an alkaline developer). It is seldom possible to identify the type of lacquer at hand except by actual trial. The following steps are suggested:

1. Removal should first be attempted with a plush pad or a wad of cotton well moistened with Kodak Film Cleaner. If after a few strokes of the pad the lacquer starts to come off, this method should be continued until all lacquer is removed.
2. If the lacquer is not affected by Kodak Film Cleaner, it can be removed in 5 per cent sodium carbonate or an alkaline developer. Treatment in either of these solutions should be followed by washing.

*Important:* If the lacquer is soluble in Kodak Film Cleaner, do not put the transparency into either water or an alkaline solution; this will cause the lacquer to wrinkle and mark the emulsion surface.

At one time an alkaline-soluble lacquer was used over the picture area of the transparency only, not over the perforations. If the lacquer can be identified in this manner, 5 per cent sodium carbonate or an alkaline developer should be used. Kodak Film Cleaner should be tried first when the lacquer extends over the entire width of the emulsion of the transparency including the perforations.

After the lacquer has been removed, the transparency should be coated with Kodak Film Lacquer according to the directions below.

## Applying Kodak Film Lacquer

Transparencies should be held flat for lacquering. Their edges can be fastened with adhesive tape to a flat surface, with the emulsion side up and the perforations completely covered with tape. A small quantity of Kodak Film Lacquer should be poured into a small, clean receptacle, then applied with a camel's-hair brush and allowed to dry in a dust-free location for 10 minutes. Unused lacquer in the receptacle should be discarded. Brushes can be cleaned with a 5 per cent sodium carbonate solution, after which they should be washed in clear water.

Kodak Film Lacquer can be removed from transparencies by soaking the transparencies in a 2 to 5 per cent solution of sodium carbonate. Within 2 minutes following visual disappearance of the lacquer, the transparencies should be removed from the carbonate solution, washed for 5 minutes in clear water, and dried thoroughly.

## COLOR PRINTS AND KODACHROME DUPLICATES

TWO COLOR printing services are available through regular Kodak dealers: Kodachrome Prints from 35mm and Bantam Kodachrome transparencies, and Kodachrome Professional Prints from Kodachrome Professional Film transparencies. Instead of a paper base, a white, pigmented cellulose acetate support is used for these prints. This gives them the "feel" of a fine playing card.

**Kodachrome Prints** are moderately priced color prints for the amateur color photographer. They reproduce the Kodachrome originals remarkably well and are an outstanding value. Their low cost is made possible by standardized production procedures.

**Kodachrome Professional Prints** are primarily intended for the commercial field. Each order receives individual attention, and the customer's instructions regarding the making of the print are followed whenever possible. Such instructions should be explicit in order to avoid misunderstandings. Every effort is made to assure finest possible reproduction of the Kodachrome originals.

### How to Order Kodachrome Prints

Kodachrome Prints can be ordered through regular Kodak dealers only.

**Standard Sizes:** The following standard print sizes are made only from 35mm and Bantam Kodachrome transparencies in regular 2 x 2-inch Kodaslide or glass mounts. Kodachrome Prints 2X and 3X show slightly less picture area than is visible through the aperture of the transparency mount.

Kodachrome Prints 2X—About  $2\frac{1}{4} \times 3\frac{1}{4}$  inches, unmounted, round corners

Kodachrome Prints 3X—About  $3 \times 4\frac{3}{8}$  inches, unmounted, round corners

Kodachrome Prints 5X—About  $5 \times 7\frac{1}{2}$  inches, in large double mounts

Kodachrome Prints 8X—About  $8 \times 11$  inches, in large double mounts

**Special Sizes:** In addition to the above, Kodachrome Prints, Special Size, can be obtained in any size up to  $11 \times 14$  inches. The special enlargements are made from any designated portion of the miniature Kodachrome transparency. If cropping is desired, it should be indicated by attaching a mask to the slide.

Kodachrome transparencies which are to be greatly enlarged must be exceedingly sharp, and of good color, but low in contrast. Originals with high contrast or large dark areas will not enlarge satisfactorily.

### How to Order Kodachrome Professional Prints

All print orders are handled through dealers and should be accompanied by *complete, clearly written* instructions. Kodachrome Professional Prints are made from all sizes of Kodachrome Professional Film trans-



parencies except 45 x 107 mm., 6 x 13 cm., and 11 x 14 inches. These prints are not available from duplicates of Kodachrome transparencies.

Kodachrome Professional Prints are currently supplied in any desired size up to a maximum of 11 x 14 inches. Prices are based on two standard sizes, 8 x 10 and 11 x 14 inches. The 8 x 10-inch prints are returned in mounts. Odd-size and 11 x 14-inch prints are returned unmounted. If cropping is desired, the print size and the portion of the picture to be enlarged to this size should be indicated clearly and accurately on an overlay. The overlay can be taped to the Kodapak sleeve containing the transparency.

### **Selection of Kodachrome Transparencies for Printing**

The Kodachrome transparencies that produce the most attractive and best quality color prints are naturally those which have been well exposed and properly lighted. Such transparencies are easily obtained by exposing Kodachrome Films as recommended in direct or hazy sunlight, or with suitable artificial illumination. In other words, Kodachrome transparencies which have been carefully exposed under good picture-taking conditions will yield good prints. Kodak dealers will be glad to assist customers in the selection of suitable transparencies.

Kodachrome pictures taken near sunrise or sunset are quite warm in color; pictures taken on overcast days or in shade are sometimes bluish. In prints from miniature transparencies, these effects are reproduced. If an unusual color rendering is pleasing in the transparency, it will usually be pleasing when reproduced in the Kodachrome Print. In any case, the color rendering in the print will be similar to that in the transparency. It is assumed that the maker likes the Kodachrome picture as it is, and the attempt is made to reproduce it as closely as possible.

In making Kodachrome Professional Prints, it is occasionally possible to improve upon the color balance of the Kodachrome original.

In projecting Kodachrome transparencies from which color prints might be ordered, remember that the eye readily adapts itself to general bluish, reddish, or other color tints in the projected image, since there are no lighted surroundings of known color for comparison. A color print, however, is viewed amid lighted, familiar surroundings to which the eye is already color adapted; its color rendering is thus judged much more critically than that of the transparency.

*To assure satisfactory results, check the transparencies carefully for the following specific points:*

**1. Color Rendering.** Compare the transparencies with others that have produced good prints. Note especially the color rendering in faces. If

Kodachrome Prints are to be grouped together on an album page, the Kodachrome originals should be viewed together on an illuminator. In this way, it is easy to see differences in color rendering which might make the prints unsatisfactory for simultaneous viewing.

**2. Definition.** The Kodachrome picture must be sharp if the enlarged color print is to be sharp. Examine the projected image closely, or check the transparency itself through a magnifying glass.

**3. Exposure.** If a correctly exposed Kodachrome transparency is held against white paper under a bright light, it appears quite dark. If it looks like a fairly good print when so viewed, it is overexposed and will not produce a good color print.

Transparencies slightly darker than normal, even those exposed one stop less than recommended, will frequently print well. Dark transparencies should be examined over a bright light. If plenty of detail is present in the shadow areas, and if these areas are pleasing in color, a satisfactory color print can be expected.

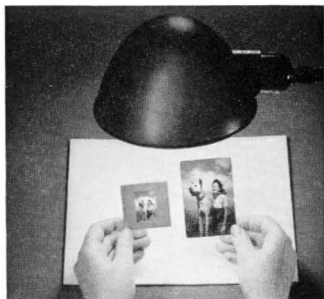
**4. Contrast.** Scenes which are evenly lighted produce excellent prints. Scenes which are side lighted, back lighted, or partly in shade are likely to have important details obscured by heavy shadows, and therefore they may not print satisfactorily. For example, a Kodachrome picture of a group of people standing partly in sunlight and partly in shade, although fairly satisfactory in the transparency, is usually disappointing in the print, because no printing process can reproduce the brightness range of such a transparency.

To check contrast, view the projected image with one eye shut, the other eye squinted. This causes dark shadows to appear darker, and the same effect may be expected in a color print.

### **Comparing Color Prints with Kodachrome Originals**

In checking print quality, it is exceedingly important to view the transparency and print simultaneously by light of the same color quality, and at balanced levels of illumination. If the transparency is viewed by strong daylight from a window and the print by weak tungsten light, there will naturally be great differences in both color rendering and brightness.

The accompanying illustration shows a simple and effective method of comparing a color print with the Kodachrome original from



which it was made. The print is held under a desk lamp for viewing as shown and the transparency viewed by light reflected from a sheet of white paper on the table underneath the same lamp.

Another satisfactory method of comparing print and transparency consists of projecting the transparency in a darkened room, and holding the print underneath a lamp behind the projector.

Either tungsten light or daylight, but not fluorescent light, is a satisfactory illuminant for Kodachrome Prints.

### **Care of Kodachrome Prints**

Kodachrome Prints contain dyes which are as stable as possible, consistent with their other requirements, but as dyes may, in time, change, the prints are not warranted against change in color. Prolonged exposure to bright daylight, and particularly to direct sunlight, should be avoided. The prints, therefore, should not be displayed for long periods of time in or near windows, or in other locations subject to direct sunlight. For the greatest degree of stability, Kodachrome Prints should be kept in an album or folder in order to protect them against continuous exposure to light.

### **KODACHROME DUPLICATES**

With the increasing use of Kodachrome Films, there has been a demand for color duplicates from Kodachrome originals. In commercial fields, duplicates are needed for illustrated lectures, for salesmen's sample kits, and for dealer displays. Duplicate transparencies of still pictures are often wanted in a size different from that of the original. Kodachrome Duplicates supplied by the Eastman Kodak Company are described below.

#### **16-mm. Kodachrome Duplicates**

Duplicates are available from either 16-mm. silent or sound Kodachrome. Orders for silent duplicates require no special preparation by the customer. In the case of 16-mm. Kodachrome sound duplicates, the sound record submitted for printing must be either a 35-mm. or 16-mm. matched positive print of high quality. When a sound track is sent in for duplicating, the proper starting point on both the sound-track film and the 16-mm. Kodachrome original should be indicated clearly and accurately, to assure synchronization.

#### **Still Kodachrome Duplicates**

The Eastman Kodak Company is prepared to make enlargements, duplicates of the same size, or reductions from original Kodachrome transparencies according to the following schedule. At the time this material was prepared, all duplication was available only from Rochester, N. Y.

## Schedule of Duplicates from Kodachrome Transparencies

### FROM

Any original Kodachrome transparency of the following size:

*24	x	36 mm (35mm)	}
†*28	x	40 mm (Bantam)	
2 1/4	x	3 1/4 in.	
2 1/2	x	3 1/2 in.	
3 1/4	x	4 1/4 in.	
4	x	5 in.	
5	x	7 in.	
†8	x	10 in.	
4.5	x	6 cm	
6.5	x	9 cm	
9	x	12 cm	}
11	x	14 in.	
45	x	107 mm	
6	x	13 cm	}

### TO

Any duplicate Kodachrome transparency of the following size:

§24	x	36 mm (35mm)
2 1/4	x	3 1/4 in.
3 1/4	x	4 1/4 in.
4	x	5 in.
5	x	7 in.
8	x	10 in.
°11	x	14 in.
6.5	x	9 cm
9	x	12 cm

{ No duplicates of any size can be made from originals of these sizes.

\*Originals may be mounted or unmounted. Duplicates are supplied in all listed sizes up to and including 5 x 7 inches.

†Same-size duplicates cannot be made from originals of this size. Duplicates of Bantam originals in the 24 x 36-mm size are slightly reduced so that the entire picture area inside the Bantam mask will be included in the 24 x 36-mm duplicate.

‡Enlarged duplicates of 8 x 10-inch transparencies are not available.

§Duplicates in the 35mm size will be returned in Kodak Ready-Mounts unless otherwise specified. They are not available in strip form. The minimum area that can be reduced to this size from Kodachrome Professional Film transparencies is 2 1/4 x 3 1/4 inches.

°Original transparencies of this size cannot be duplicated, but 11 x 14-inch enlarged duplicates can be made from smaller sizes.

NOTE: Kodachrome Professional Film transparencies should not be sent for duplication bound between glass. A six-diameter enlargement is the maximum that will be supplied from any Kodachrome transparency.

## TITLING AND COPYING SERVICE IN 16MM KODACHROME FILM

**Copying Service:** Pictures, drawings, maps, etc., from 1 5/8 x 2 1/2 to 11 x 14 inches can be copied and supplied on 16mm Kodachrome Film.

**Titles in 16mm Kodachrome** are supplied with a red background and black-and-yellow border. The order should specify whether the titles are for use with an original or duplicate. These two services are available only from Rochester, N. Y.

Sharp Kodachrome transparencies, which show soft, even lighting, yield beautiful Kodachrome Prints.



## **COLOR PRINTING BY THE KODAK DYE TRANSFER PROCESS**

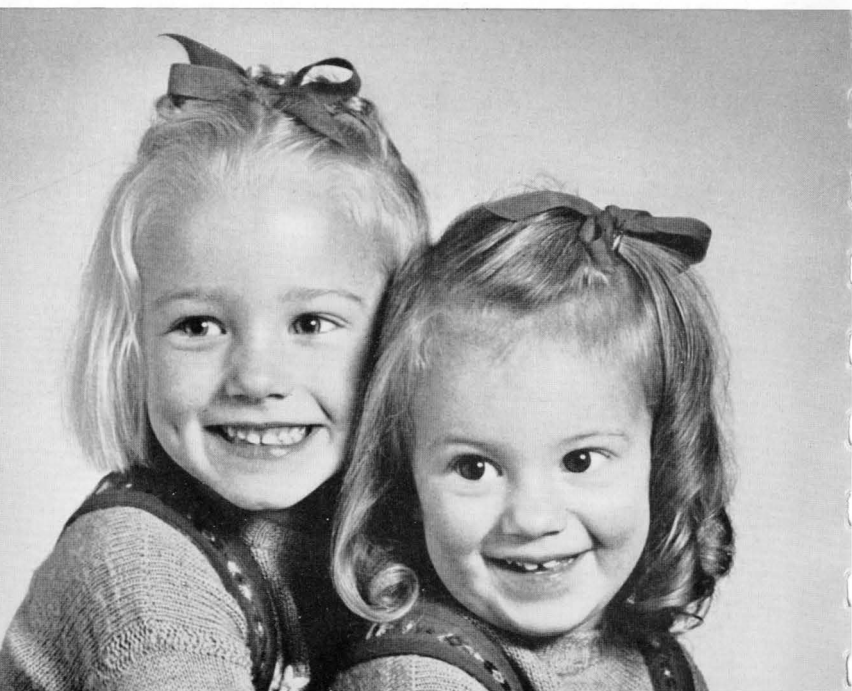
The Kodak Dye Transfer Process is a greatly improved and much faster method of making color prints from color-separation negatives. Such negatives can be made from Kodachrome transparencies, directly from the subject by means of a one-shot camera, or by successive exposures through filters in an ordinary camera. For information see your Kodak dealer or write Sales Service Division, Eastman Kodak Company, Rochester 4, New York.

## **MAKING BLACK-AND-WHITE PRINTS OF KODACHROME FILM FRAMES AND TRANSPARENCIES**

Enlarged black-and-white prints of 16mm Kodachrome Film frames, 24 x 36-mm or 28 x 40-mm Kodachrome transparencies, plus same-size, reduced, or enlarged monochrome prints of Kodachrome Professional Film transparencies are frequently desired for albums, Christmas cards or gifts.

To make such prints, it is necessary first to make negatives on film from the transparencies. These, as well as the desired prints, can be

Reproduction from a black-and-white print made from a miniature Kodachrome transparency.



made with a minimum of darkroom equipment. Also, all work can be done without damage to any film original.

Negatives of 16mm Kodachrome Film frames, and 24 x 36-mm or 28 x 40-mm transparencies, should be enlarged. Negatives of Kodachrome Professional Film transparencies can be enlarged, printed same-size, or reduced.

Although properly exposed Kodachrome originals will, of course, produce the best results, improperly exposed transparencies often yield negatives sufficiently satisfactory for printing.

The original Kodachrome transparencies from which negatives are to be made must be both sharp and clean. Fingerprints or oily smudges can usually be removed by breathing on the transparencies and wiping them gently with a soft cloth. If this is not successful, the transparencies should be wiped with a pad of plush or cotton moistened slightly with Kodak Film Cleaner.\* The moistened pad should be used with light, even strokes.

Dust and lint can be removed from the surface of transparencies with a camel's-hair or other soft brush.

In some instances, the use of filters will aid in obtaining better negatives for printing. The same rules apply for their use as apply when original color subjects are photographed through filters on black-and-white film, with one exception; a yellow, orange or red filter used to penetrate atmospheric haze in original scenic subjects will not eliminate haze recorded in color transparencies.

### **16mm Film Frames and 24 x 36-mm or 28 x 40-mm Transparencies**

Enlarged black-and-white film negatives can be made with a conventional enlarger such as the Kodak Precision Enlarger as follows:

Place the selected film frame or transparency surrounded with a mask in the negative carrier of the enlarger. Cover the enlarger lamp house with a black hood to eliminate all stray light. Frame and focus the film frame or transparency image on the enlarger easel. Place a sheet of Kodak Panatomic-X Sheet Film on the easel and make a test exposure.

Developed negatives can be used to make reduced, same-size, or enlarged paper prints in the regular manner.

### **Kodachrome Professional Film Transparencies**

**Enlarged black-and-white film negatives** for making paper prints can be made of 4 x 5-inch or smaller Kodachrome Professional Film

\*Fumes of this cleaner are toxic if inhaled. The cleaner should be used sparingly and only in a well-ventilated room.

transparencies in an enlarger such as the Kodak Precision Enlarger.

The color transparency is placed in the negative carrier of the enlarger, masked, the image focused on the enlarger easel and the exposure made as previously described.

**Same-size negatives** of color transparencies can be made by contact printing. A darkroom, a printer such as the Kodak All-Metal Printer, and sheet film are required. Kodak Panatomic-X Sheet Film is recommended.

Transparencies must be removed from their mounts and placed with the emulsion side in contact with the emulsion side of the negative film. The correct exposure can be determined by test.

**Reduced negatives** can be made from Kodachrome Professional Film transparencies by using the Kodak Precision Enlarger and appropriate accessories. For making 24 x 36-mm negatives, a 35mm Kodachrome Adapter is necessary; for 28 x 40-mm negatives, a Bantam Kodachrome Adapter is required. For 2¼ x 3¼-inch negatives, a Camera Back Adapter, Ground Glass Focusing Back, and suitable film holders are required. A lens of suitable focal length for the negative size and degree of reduction, and an illuminator are also required.

A Kodak All-Metal Printer can be used as an illuminator for transparencies up to 4 x 5 inches, or a Kodachrome Illuminator 8 x 10 can be mounted in a horizontal position.

The transparency to be copied must be placed on the illuminator and all white light around the edges masked off with opaque paper. With the lens of the Kodak Precision Enlarger set at the *f*/16 opening for a 3¼ x 4¼-inch Kodachrome transparency on a Kodachrome Illuminator 8 x 10, the exposure time required for making a 24 x 36-mm or 28 x 40-mm negative on Kodak Panatomic-X Film will be about 2 seconds. For a 2¼ x 3¼-inch negative on Kodak Panatomic-X Sheet Film the exposure time required will be about 6 seconds.

After a film has been exposed, it should be removed from the adapter and processed as recommended in the following paragraph. Prints can be made from the processed films with the enlarger or by contact printing with a Kodak All-Metal or similar printer.

### **Processing**

Kodak Panatomic-X Film should be developed in Kodak D-76 at 68°F for about 5 minutes (tray) or 7 minutes (tank). Negatives made by contact printing will generally require less development than those made by projection with enlargers having diffuse optical systems.

## KODACHROME FILM, DAYLIGHT TYPE

**General Properties:** A color film for general outdoor use in miniature and home movie cameras, yielding full-color transparencies for projection. Miniature Kodachrome transparencies can also be used to obtain Kodachrome Prints, or black-and-white prints. Duplicates are available from both miniature and 16mm Kodachrome. The miniature transparencies can be reproduced by photomechanical methods, the Kodak Dye Transfer Process, or other processes of color printing.

**Exposure Index:** *Daylight*—10 *Tungsten*—4\*

These values are recommended as settings for meters using A.S.A. Exposure Indexes. In daylight, certain meters should be pointed downward to minimize the effect from the sky, in accordance with the manufacturer's instructions.

With older meters, the following settings are suggested:

Weston	<i>Daylight</i> —8	<i>Tungsten</i> —3*
General Electric	<i>Daylight</i> —12	<i>Tungsten</i> —5*

\*With Kodachrome Filter for Photoflood.

Filters	PURPOSE
Kodachrome Filter for Photoflood	Permits use of this film in Photoflood light
Kodachrome Haze Filter	Absorbs ultraviolet, reducing distant haze
Kodak CC33	For use with Daylight Fluorescent lamps, to obtain warmer results than with no filter
Kodak CC23 or no filter	White Flame Carbon arc lamps
Kodak Pola-Screen	Dark blue sky effects (requires one stop greater than normal exposure)

**Daylight Exposure Table—Still Cameras:** Daylight Type Kodachrome. Lens apertures at 1/50 second shutter time.

LIGHTING	BASIC EXPOSURE FOR AVERAGE SUBJECTS	LIGHT-COLORED SUBJECTS	DARK-COLORED SUBJECTS	SIDE-LIGHTED SUBJECTS	BACK-LIGHTED SUBJECTS
Bright, Direct Sunlight	Between f/5.6 and f/8	f/8	f/5.6	Between f/5.6 and f/8*	f/4.5*
Weak, Hazy Sun—No Distinct Shadows Cast	f/4.5	f/5.6	f/4		
Sky Overcast	f/3.5	f/4	f/2.8		
Cloudy, but Bright	Between f/2 and f/2.8	f/2.8	f/2		
Open Shade on Bright Day					
*Assuming shadow areas are unimportant. With close-ups having important shadow areas, use one full stop larger.					

**Supplementary Flash to Illuminate Shadows in Outdoor Subjects:** To reduce excessive lighting contrast, blue-bulb Photoflash Lamps, Nos. 5B and 22B, provide a handy means of illuminating shadow areas with light approximating daylight in color quality. The lamps should be used in a correctly adjusted synchronizer having an efficient reflector.



With bright sunlight and a clear blue sky, a desirable lighting ratio of about three-to-one is obtained by using the No. 22B lamp at 12 feet or the No. 5B lamp at 8½ feet. At closer distances, a clean white handkerchief can be draped over the synchronizer reflector to maintain this ratio. The following table is based on the use of Kodachrome Film, Daylight Type, with an exposure of 1/50 second between f/5.6 and f/8.

LAMP-TO-SUBJECT DISTANCE	USE OF HANDKERCHIEF WITH 5B LAMP	USE OF HANDKERCHIEF WITH 22B LAMP
4 ft.	2 thicknesses	—
6 ft.	1 thickness	2 thicknesses
8½ ft.	no handkerchief	1 thickness
12 ft.	—	no handkerchief

**Photoflash Guide Numbers** for using Nos. 5B and 22B lamps indoors, without daylight, in average synchronizer reflectors. Divide proper guide number by distance in feet from lamp to subject. This gives recommended lens opening for average subjects in average rooms with light-colored walls and ceilings.

No. 22B Lamp: Open flash—50; 1/100 sec.—40; 1/200 sec.—25

No. 5B Lamp: Open flash—45; 1/100 sec.—35; 1/200 sec.—25

**Daylight Exposure Table—Amateur Motion-Picture Cameras:** With 8mm and 16mm Kodachrome, at 16 frames per second (1/30 second shutter time).

LIGHTING	BASIC EXPOSURE FOR AVERAGE SUBJECTS	LIGHT- COLORED SUBJECTS	DARK- COLORED SUBJECTS	SIDE- LIGHTED SUBJECTS	BACK- LIGHTED SUBJECTS
Bright, Direct Sunlight	f/8	Between f/8 and f/11	Between f/5.6 and f/8	f/8*	f/5.6*
Weak, Hazy Sun—No Distinct Shadows Cast	f/5.6	Between f/5.6 and f/8	Between f/4 and f/5.6		
Sky Overcast, Cloudy, but Bright	f/4	Between f/4 and f/5.6	f/2.8 and f/4		
Open Shade on Bright Day	f/2.8	Between f/2.8 and f/4	f/1.9 and f/2.8		
*Assuming shadow areas are unimportant. With close-ups having important shadow areas, use one full stop larger.					

**Photoflood Exposure Tables—Still Cameras and Amateur Motion-Picture Cameras:** See leaflet packed with “Kodachrome Filter for Photoflood.”

#### Rolls Available for Miniature Cameras:

*K135 20 and 36-exposure rolls (standard frame-size—24 x 36mm) for Kodak Ektra, Kodak 35's, Kodak Retinas, Leica, Contax, and similar 35mm cameras.*

*K828 8-exposure rolls (standard frame-size—28 x 40mm) for Kodak Bantam Special, Kodak Bantams f/4.5 and f/5.6.*

#### Rolls Available in 8 and 16mm Film:

*50 and 100-ft. rolls for Ciné-Kodaks and other 16mm cameras.*

*200-ft. rolls for 200-ft. magazine of Ciné-Kodak Special.*

*50-ft. magazines for Magazine Ciné-Kodak, Filmo 141, and Zeiss Movikon K.*

*50-ft. packettes for Simplex Pockette and Filmo 121.*

*100, 200, and 400-ft. rolls with single row perforations for 16mm sound recording.*

*25-ft. rolls for Ciné-Kodak 8's and other 8mm cameras accommodating film in the 16mm width.*

*25-ft. magazines for Magazine Ciné-Kodak 8.*

## 40 COLOR FILMS

## KODACHROME FILM, TYPE A

**General Properties:** A color film to be used in miniature and home movie cameras, for use with high-efficiency tungsten lamps (Photoflood-type), yielding full-color transparencies for projection. Miniature Kodachrome transparencies can also be used to obtain Kodachrome Prints, or black-and-white prints. Duplicates are available from both miniature and 16mm Kodachrome. The miniature transparencies can be reproduced by photomechanical methods, the Kodak Dye Transfer Process, or other processes of color printing.

**Exposure Index:** *Tungsten—16* *Daylight—10\**  
These values are recommended as settings for meters using ASA Exposure Indexes. In daylight, certain meters should be pointed downward to minimize the effect from the sky, in accordance with the manufacturer's instructions. With early model meters, the following settings are suggested:

Weston	<i>Tungsten—12</i>	<i>Daylight—8*</i>
General Electric	<i>Tungsten—20</i>	<i>Daylight—12*</i>

\*With Kodachrome Type A Filter for Daylight.

These values apply if the meter reading is taken from the camera position and the subject has average reflectance. In artificial light, the reading can be made on a matte white card held close in front of the subject, facing the camera, if the values given above are divided by 5 and then rounded off to the nearest setting on the meter scale. The back of clean, white, double-weight photographic paper is recommended for this purpose. If the card method is used, some allowance must be made for unusually light- or dark-colored subjects.

For other techniques of making meter readings, adjustments in the Exposure Index values may be necessary.

**Copying and Close-Up Work:** Whenever the subject is closer than 8 times the focal length of the lens, allowance should be made for the decrease in effective lens aperture due to bellows extension. In copying and close-up work, the use of a white card as described above is recommended for determining exposure settings.

Filters	To PERMIT EXPOSURE BY
Kodachrome Type A Filter for Daylight Kodak CC15 Kodak CC4 Kodak CC34 Kodak CC23	Daylight  Wire-filled or shredded foil Photoflash Lamps 3200° K. lamps White Fluorescent lamps SM Photoflash Lamp, for warmer results than are obtained with no filter

**Photoflood Exposure Table—Still Cameras:** Basic Exposure Table for Kodachrome Film, Type A, with No. 2 Photofloods in Kodaflectors (matte side), or with Reflector Photofloods.

SHUTTER TIME IN SECONDS	NUMBER OF LAMPS	LAMP-TO-SUBJECT DISTANCE WITH NO. 2 OR REFLECTOR PHOTOFLOOD LAMPS					
		<i>f</i> /2	<i>f</i> /2.8	<i>f</i> /3.5	<i>f</i> /4	<i>f</i> /4.5	<i>f</i> /5.6
1/25 or 1/20	1 2 3	5 ft 7½ ft 9 ft	3¾ ft 5½ ft 6½ ft	3 ft 4¼ ft 5 ft	3½ ft 4½ ft	3¼ ft 4 ft	3¼ ft
1/5 or 1/4	1 2 3	12 ft 17 ft 21 ft	8½ ft 12 ft 15 ft	6½ ft 9½ ft 12 ft	6 ft 8½ ft 10 ft	5½ ft 7½ ft 9½ ft	4 ft 6 ft 7½ ft

Note: Do not use more than three No. 2 or Reflector Photofloods on a single fused circuit.

**Photoflash Exposures** through Kodak CC15 Filter on K135A and K828A films, for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings or outdoors at night, give four times the indicated exposure.

No. 22 lamp in Kodaflector (matte side)	7'	10'	14'	20'	28'
Lens aperture for open-flash exposures:	<i>f</i> /22	<i>f</i> /16	<i>f</i> /11	<i>f</i> /8	<i>f</i> /5.6

**Photoflash Guide Numbers:** The following table gives Guide Exposure Numbers for use with Mazda Photoflash Lamps when flashed in an average synchronizer reflector. To obtain the proper *f*-number, divide the Guide Number by the distance in feet from lamp to subject. The answer is the recommended lens opening for average subjects in average-size rooms with light-colored walls and ceilings.

BETWEEN-THE-LENS SHUTTERS					FOCAL-PLANE SHUTTERS		
SHUTTER TIME	SM†	No. 5*	No. 11*	No. 22*	SHUTTER TIME	No. 6*	No. 31*
Open, 1/25, 1/50	50	90	100	145	1/50	65	70
1/100	50	75	80	115	1/100	45	50
1/200	35	60	65	90	1/250	30	35

†No filter or Kodak CC23 for slightly warmer results. \*With the Kodak CC15 Filter.

**Daylight Exposure Table—Still Cameras:** Use the “Daylight Exposure Table—Still Cameras” in Data Sheet for Kodachrome Film, Daylight Type. A Kodachrome Type A Filter for Daylight must be on the camera lens.

**Photoflood Exposure Table—Amateur Motion-Picture Cameras:** With 8mm and 16mm Kodachrome Type A, operating at 16 frames per second (1/30 second shutter time), using Kodaflectors with No. 1 Photoflood Lamps.

Number of No. 1 Photoflood Lamps and Distance from Lamps to Subject	2 at 9 ft. or 3 at 11 ft. or 4 at 13 ft.	2 at 6½ ft. or 3 at 7½ ft. or 4 at 9 ft.	2 at 4½ ft. or 3 at 5½ ft. or 4 at 6½ ft.	2 at 3 ft. or 3 at 3¾ ft. or 4 at 4½ ft.
Diaphragm Opening and Camera Speed	<i>f</i> /1.9 Normal Speed or <i>f</i> /2.8 Half Speed	<i>f</i> /2.7 or <i>f</i> /2.8 Normal Speed or <i>f</i> /4 Half Speed	<i>f</i> /4 Normal Speed or <i>f</i> /5.6 Half Speed	<i>f</i> /5.6 Normal Speed or <i>f</i> /8 Half Speed

**Daylight Exposure Table—Amateur Motion-Picture Cameras:** Use the “Daylight Exposure Table—Amateur Motion-Picture Cameras” in the Data Sheet for Kodachrome Film, Daylight Type. A Kodachrome Type A Filter for Daylight must be on the camera lens.

#### Rolls Available for Miniature Cameras:

*K135 20 and 36-exposure rolls (standard frame-size—24 x 36mm) for Kodak Ektra, Kodak 35's, Kodak Retinas, Leica, Contax, and similar 35mm cameras.*

*K828 8-exposure rolls (standard frame-size—28 x 40mm) for Kodak Bantam Special, Kodak Bantams *f*/4.5 and *f*/5.6.*

#### Rolls Available in 8 and 16mm Film:

*50 and 100-ft. rolls for Ciné-Kodaks and other 16mm cameras.*

*200-ft. rolls for 200-ft. magazine of Ciné-Kodak Special.*

*50-ft. magazines for Magazine Ciné-Kodak, Filmo 141, and Zeiss Movikon K.*

*50-ft. packettes for Simplex Pockette and Filmo 121.*

*100, 200, and 400-ft. rolls with single row perforations for 16mm sound recording.*

*25-ft. rolls for Ciné-Kodak 8's and other 8mm cameras accommodating film in the 16mm width.*

*25-ft. magazines for Magazine Ciné-Kodak 8.*

# KODACHROME PROFESSIONAL FILM

## DAYLIGHT TYPE

Code Notch

**General Properties:** A fast color sheet film for outdoor use. This film yields full-color transparencies of high quality which can be viewed by transmitted light, projected, or used to obtain Kodachrome Professional Prints. The transparencies are also well suited to reproduction by photomechanical methods, the Kodak Dye Transfer Process, or other processes of color printing. Black-and-white prints can be made by means of intermediate negatives. Kodachrome Duplicates are also available.

### Exposure Index: *Daylight—12*

This value is recommended as a setting for meters using A.S.A. Exposure Indexes. A setting of 10 is suggested for older meters calibrated for Weston ratings, 16 for older General Electric meters. In daylight, certain meters should be pointed downward to minimize the effect from the sky, in accordance with the manufacturer's instructions.

### Filters and Purposes:

FILTER	PURPOSE
Wratten Nos. 1, 2A	These filters are used to avoid the bluish cast which is otherwise evident in (a) pictures taken on an overcast day, (b) pictures taken in shade under a clear blue sky, and (c) distant scenes, mountain views, high-altitude aerial shots, etc. Color rendering in daylight becomes warmer with the No. 1 filter, still warmer with the No. 2A.
Kodak CC15	For use with Kodatron Flash Tube, Type II.
Kodak CC33	Compensating filter for Daylight Fluorescent lamps, for slightly warmer results than are obtained with no filter.
Kodak CC23	Compensating filter for White Flame Carbon arc lamps.

The above filters are quite pale and absorb so little light that no allowance in exposure need be made.

**Daylight Exposure Table:** Kodachrome Professional Film, Daylight Type. Lens apertures at 1/50 second shutter time.

LIGHTING	BASIC EXPOSURE FOR AVERAGE SUBJECTS	LIGHT- COLORED SUBJECTS	DARK- COLORED SUBJECTS	SIDE- LIGHTED SUBJECTS	BACK- LIGHTED SUBJECTS
Bright, Direct Sunlight	<i>f/8</i>	Between <i>f/8</i> and <i>f/11</i>	Between <i>f/5.6</i> and <i>f/8</i>	<i>f/8*</i>	<i>f/5.6*</i>
Weak, Hazy Sun—No Distinct Shadows Cast	<i>f/5.6</i>	<i>f/5.6</i> and <i>f/8</i>	<i>f/4</i> and <i>f/5.6</i>		
Sky Overcast— Cloudy, but Bright	<i>f/4</i>	<i>f/4</i> and <i>f/5.6</i>	<i>f/3.5</i>		
Open Shade on Bright Day		<i>f/3.5</i>			

\*Assuming shadow areas are unimportant. With close-ups having important shadow areas, use one full stop larger.

**Photoflash Guide Numbers** for the use of Nos. 5B and 22B Photoflash Lamps indoors, independently of daylight, in average synchronizer reflectors. Divide the proper guide number by the distance in feet from lamp to subject. This is the recommended lens opening for average subjects in average rooms with light-colored walls and ceilings.

No. 22B Lamp: Open flash—55; 1/100 sec.—45; 1/200 sec.—28

No. 5B Lamp: Open flash—50; 1/100 sec.—40; 1/200 sec.—25

**Supplementary Flash to Illuminate Shadows in Outdoor Subjects:** To reduce excessive lighting contrast, blue-bulb Photoflash Lamps, Nos. 5B and 22B, provide a handy means of illuminating shadow areas with light approximating daylight in color quality. The lamps should be used in a correctly adjusted synchronizer having an efficient reflector.

*With bright sunlight and a clear blue sky*, a desirable lighting ratio of about three-to-one is obtained by using the No. 22B lamp at 12 feet or the No. 5B lamp at 8½ feet. At closer distances, a clean white handkerchief can be draped over the synchronizer reflector to maintain this ratio. The following table is based on the use of Kodachrome Professional Film, Daylight Type, with an exposure of 1/50 second at *f*/8.

LAMP-TO-SUBJECT DISTANCE	USE OF HANDKERCHIEF WITH 5B LAMP	USE OF HANDKERCHIEF WITH 22B LAMP
4 ft.	2 thicknesses	—
6 ft.	1 thickness	2 thicknesses
8½ ft.	no handkerchief	1 thickness
12 ft.	—	no handkerchief

**Exposure Table: Daylight Photoflood Lamps Used to Supplement Daylight.**

In Kodachrome photography, Daylight (blue-bulb) Photoflood Lamps are especially useful for supplementing daylight illumination of indoor subjects such as home interiors, furniture exhibits, show windows, and other merchandise displays. When these lamps are used with living models, or independently of daylight, results are quite warm in hue.

The use of a photoelectric exposure meter is recommended for balancing illumination and determining exposures when Daylight Photoflood Lamps are used in the above manner. In the absence of an exposure meter the tables below will serve as a rough guide. These tables assume (1) that the daylighted portions of the subject are illuminated by diffuse daylight, not by direct sunlight, and (2) that daylight affords approximately half the illumination of the subject.

Use the exposures indicated for two lamps only when two lamps are used together to illuminate the same part of the subject, and not when a number of lamps are used separately to illuminate extended areas of the subject.

FOR STILL PICTURES WITH DAYLIGHT TYPE KODACHROME FILMS						
EXPOSURE TIME 2 SECONDS						
NUMBER OF LAMPS	NO. 1 DAYLIGHT PHOTOFLOODS IN KODAFLECTORS (MATTIE SIDE)			NO. 2 DAYLIGHT PHOTOFLOODS IN KODAFLECTORS (MATTIE SIDE)		
	AVERAGE LAMP-TO-SUBJECT DISTANCE			AVERAGE LAMP-TO-SUBJECT DISTANCE		
	7½ ft.	11 ft.	16 ft.	10 ft.	14 ft.	20 ft.
1	<i>f</i> /5.6	<i>f</i> /4	<i>f</i> /2.8	<i>f</i> /5.6	<i>f</i> /4	<i>f</i> /2.8
2	<i>f</i> /8	<i>f</i> /5.6	<i>f</i> /4	<i>f</i> /8	<i>f</i> /5.6	<i>f</i> /4

**Film Sizes Available:** (For all cameras accommodating sheet film in these sizes).  
Inch-sizes: 2¼ x 3¼, 2½ x 3½, 3¼ x 4¼, 4 x 5, 5 x 7, 8 x 10, and 11 x 14.  
Centimeter-sizes: 4.5 x 6, 6.5 x 9, 9 x 12, 4.5 x 10.7, and 6 x 13.

# KODACHROME PROFESSIONAL FILM

## TYPE B (Improved Speed)

Code Notch

**General Properties:** A color sheet film for use with high-efficiency tungsten lamps burning at 3200° Kelvin. This film yields full-color transparencies of high quality which can be viewed by transmitted light, projected, or used to obtain Kodachrome Professional Prints. The transparencies are also well suited to reproduction by photo-mechanical methods, the Kodak Dye Transfer Process, or other processes of color printing. Black-and-white prints can be made by means of intermediate negatives. Duplicates are also available.

### Exposure Index: *Tungsten—10*

This value is recommended as a setting for meters using ASA Exposure Indexes. A setting of 8 is suggested for early model meters calibrated for Weston ratings, 12 for early model General Electric meters.

These values apply if the meter reading is taken from the camera position and the subject has average reflectance. In artificial light, the reading can be made on a matte white card held close in front of the subject, facing the camera, if the values given above are divided by 5 and then rounded off to the nearest setting on the meter scale. The back of clean, white, double-weight photographic paper is recommended for this purpose. If the card method is used, some allowance must be made for unusually light- or dark-colored subjects.

For other techniques of making meter readings, adjustments in the Exposure Index values may be necessary.

**Copying and Close-Up Work:** Whenever the subject is closer than 8 times the focal length of the lens, allowance should be made for the decrease in effective lens aperture due to bellows extension. In copying and close-up work, the use of a white card as described above is recommended for determining exposure settings.

### Filters and Purposes:

FILTER	PURPOSE
Kodak CC13 Wratten No. 2A	Photoflood Lamps Photoflash Lamps
Kodak CC25 plus CC34	Compensating filter combination for White Fluorescent Lamps

**3200°K Lamp Exposure Table:** Based on the use of two 500-w PS-25 3200°K lamps being used in bowl-type, studio reflectors within 45° of the camera-subject axis. A satisfactory portrait lighting is obtained by placing one lamp near the camera at lens level, the other considerably higher and at an angle of approximately 45°.

DISTANCE, LAMPS TO SUBJECT	CAMERA SETTINGS*
5 ft	<i>f</i> /16, 1 sec
7 ft	<i>f</i> /11, 1 sec
10 ft	<i>f</i> /8, 1 sec
14 ft	<i>f</i> /5.6, 1 sec
20 ft	<i>f</i> /5.6, 2 sec

\*These values are intended for use as a guide. They will vary somewhat, according to the shape and surface properties of the reflector, the position of the bulb in the reflector, and the age of the lamp.

### Photoflash Exposure Table:

The following values apply when light from all lamps is directed at the same part of the subject, and when exposures are made in rooms with light-colored walls and ceilings. Outdoors at night or indoors with dark-colored surroundings or dark-colored objects, use two lens openings larger.

FOR OPEN-FLASH EXPOSURES WITH WRATTEN FILTER NO. 2A AND PHOTOFLASH LAMPS IN LARGE STUDIO REFLECTORS								
DISTANCE IN FEET FROM LAMPS TO SUBJECT	NUMBER OF NO. 22 LAMPS				NUMBER OF NO. 50 LAMPS			
	1	2	4	8	1	2	4	8
	<i>f</i> -NUMBERS				<i>f</i> -NUMBERS			
6	18							
7 1/2	16	22						
9	12.5	18	25		18	25		
11	11	16	22		16	22		
13	9	12.5	18	25	12.5	18	25	
15	8	11	16	22	11	16	22	
18	6.3 *	9	12.5	18	9	12.5	18	25
21	5.6	8	11	16	8	11	16	22
25	4.5	6.3	9	12.5	6.3	9	12.5	18
30	4.0	5.6	8	11	5.6	8	11	16
35	3.5	4.5	6.3	9	4.5	6.3	9	12.5
40	2.8	4.0	5.6	8	4.0	5.6	8	11
50		3.5	4.5	6.3	3.5	4.5	6.3	9
60		2.8	4.0	5.6	2.8	4.0	5.6	8
70			3.5	4.5		3.5	4.5	6.3
80			2.8	4.0		2.8	4.0	5.6
95				3.5			3.5	4.5

**Photoflash Guide Numbers:** The following table gives Guide Exposure Numbers for use with Photoflash Lamps when flashed in an average synchronizer reflector. To obtain the proper *f*-number, divide the Guide Number by the distance in feet from lamp to subject. The answer is the recommended lens opening for average subjects in average-size rooms with light-colored walls and ceilings.

BETWEEN-LENS SHUTTERS	No. 5*	No. 11*	No. 22*	FOCAL-PLANE SHUTTERS	No. 6*	No. 31*
Open, 1/25, 1/50	75	80	105	1/50	55	60
1/100	65	65	85	1/100	35	40
1/200	40	40	60	1/250	20	25

\*With Wratten Filter No. 2A

**Film Sizes Available:** (For all cameras accommodating sheet film in these sizes).  
Inch-sizes: 2 1/4 x 3 1/4, 2 1/2 x 3 1/2, 3 1/4 x 4 1/4, 4 x 5, 5 x 7, 8 x 10, and 11 x 14.  
Centimeter-sizes: 4.5 x 6, 4.5 x 10.7, 6 x 13, 6.5 x 9, and 9 x 12.







# HOW THE KODACHROME PROCESS WORKS

THERE are two general methods which can be used in color photography:

**1.** The “additive” depends upon the addition of red, green, and blue light. An example of this method is the use of microscopic dots of red, green, and blue over the entire picture area, these dots being added together by the eye without the perception of the individual dots as such. **2.** The “subtractive” employs superimposed layers of cyan, magenta, and yellow which exert independent control of the primary colors—red, green, and blue.

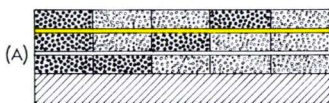
Kodachrome Film, a “subtractive” process, has three emulsion layers coated on the film support and separated by gelatin layers. All three layers, so thin that their total thickness scarcely exceeds that of the emulsion layer of a black-and-white film, are on a safety film base which has an antihalation backing.

## REPRODUCTION OF COLORED SUBJECTS BY KODACHROME FILM

ORIGINAL SUBJECT



REPRODUCTION OF ORIGINAL



DEVELOPED NEGATIVE AFTER  
CAMERA EXPOSURE



LAYERS OF EMULSION AFTER TREATMENT  
IN DYE-COUPLER DEVELOPERS



THE SILVER IS REMOVED FROM ALL THREE  
LAYERS, LEAVING COLOR IMAGES  
COMPOSED OF DYED GELATIN



PROJECTION LIGHT

## Exposure of the Three Kodachrome Layers

The picture on the top emulsion is taken by blue light, on the middle emulsion by green, and on the bottom emulsion by red light. This is not accomplished by blue, green, and red filters, but in the following way: The top emulsion is sensitive to *blue* light only. The *green* and the *red* light pass through it without affecting it, so that the *blue* light alone makes the exposure. A yellow filter layer above the middle emulsion prevents any *blue* light from reaching the two lower emulsions. The middle emulsion is sensitive to *green* but not to *red*. It is sensitive to *blue* as all emulsions are, but the *blue* light cannot reach it, and the *red* light passes through without affecting it. Therefore, the exposure is made by *green* light. The bottom emulsion is sensitive to *red* but not to *green*. It is also sensitive to *blue*, but the *blue* light cannot reach it, and the *green* light does not affect it. Hence, the picture is taken by *red* light alone.

## Reproduction of Colors in Projection

Diagram A on the opposite page shows how the film looks in cross-section after camera exposure and first development of the emulsion layers to negative images. Diagram B shows the appearance of the film after coupler development has been completed. In Diagram C, the silver has been removed and white light from a projection lamp is transmitted through the film to a screen, giving an image in the colors of the original subject. A complete understanding of the manner in which screen images in color are secured with Kodachrome can best be achieved by tracing the passage of light through the dye layers. It is suggested that the reader follow closely the right-hand side of the diagram while reading the following paragraph.

White light (on the screen) is secured by the unobstructed passage of light from the projector lamp to the screen. *Red* light results when a ray of white light is filtered by successive layers of magenta and yellow dye. The magenta layer absorbs green, leaving only blue and red. The yellow layer in turn absorbs blue, leaving only red. To secure *green* light, the blue-green layer absorbs red, leaving green and blue. The yellow layer then absorbs blue, and green light proceeds to the screen. For *blue* light, the blue-green layer again subtracts red, leaving blue and green. The magenta layer then takes out the green, leaving only blue. Intermediate colors and mixtures are secured by partial absorptions at each layer. Heavy dye deposits in all three layers subtract light of all colors, resulting in a black screen image.

# KODACOLOR ROLL FILM — KODACOLOR PRINTS

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WITH Kodacolor Film and Prints, the Eastman Kodak Company in 1942 introduced a revolutionary new process of color photography. For the first time, it became possible for the owner of an ordinary roll-film camera to make color negatives and obtain color prints at relatively low cost—and as easily as black-and-white negatives and prints.

The Kodacolor Process reproduces colors with sufficient fidelity to afford attractive color prints. It is not intended for the making of color records, or for matching or measuring colors.

**Kodacolor Roll Film** is intended for sunlight exposure and has sufficient speed to be used in the simplest types of folding and box cameras. The exposed film is returned to a Kodak dealer for development to negatives by the Eastman Kodak Company without charge. The original price of the film does not include the making of prints.

A Kodacolor negative looks much like a black-and-white negative, but contains colors complementary to the colors of the original subject. The negative image is composed entirely of dye. Although Kodacolor negatives are primarily designed for the making of Kodacolor Prints, they can also be used to produce black-and-white prints and enlargements on regular photographic papers.

In addition to the negative color image, Kodacolor negatives now contain a low-contrast positive “mask” which results in a gray tone extending to the edges of the film. This mask improves the quality of the prints. The mask makes Kodacolor negatives appear dense regardless of whether or not the film has been correctly exposed. A correctly exposed negative shows detail in both highlight and shadow areas. When the negative is underexposed, detail is lacking in the light parts of the negative.

**Kodacolor Prints** are made from Kodacolor negatives *upon order through a Kodak dealer*. Prints are not included in the original price of the film. All Kodacolor Prints are made to a standard width of  $2\frac{7}{8}$  inches, plus margins, the length of the print being dependent upon the proportions of the negative.

**Storage:** General recommendations made for the storage of Kodachrome Film are applicable for Kodacolor Film.

## EQUIPMENT FOR KODACOLOR PICTURES

**Cameras** to use in exposing Kodacolor Film range from the simple box

models to the Kodak Medalist with its many refinements. Outstanding among the famous folding Kodaks are the Vigilants and Monitors. The many models of Jiffy Kodaks and Brownies are also suitable for Kodacolor picture taking. Any camera which takes one of the following film sizes will accept Kodacolor Film: 127, 620, 120, 616, and 116.

**Loading Procedure:** In the great majority of cameras, Kodacolor Films are loaded, advanced, and unloaded in the same manner as black-and-white roll films, except that there are six standard exposures per roll instead of the eight exposures customary with black-and-white films. Certain cameras make 10, 12, 15, or 16 pictures on the regular eight-exposure roll; these cameras make 8, 9, 11, or 12 pictures on the six-exposure roll of Kodacolor Film.

Kodacolor Film should not be loaded in direct sunlight or strong artificial light. It is suggested that the film be loaded indoors or in the shade.

**Special Winding Procedures.** It is unnecessary to employ special winding procedures with most cameras. The film is simply loaded in the normal manner, the maximum number of exposures made, and the film wound off. With automatic film-positioning cameras, it is necessary to trip the shutter or to release the stop device as many times as required to permit winding until the end of the backing paper has passed the film window.

In the case of a very few reflex cameras, the film advance is controlled by turns of the take-up spool and is therefore affected by the film thickness. These cameras include the Korelle Reflex, also the "old standard" Rolleiflex model which does not have automatic shutter setting, and with which only the first exposure is positioned in the film window. To obtain the maximum number of exposures with these cameras, the following special winding procedure is recommended:

When using C120 film, wind the film to the star following the arrow and set the exposure counter at No. 1. Advance the film until No. 3 appears on the counter to make the first exposure. Make the second exposure at No. 4, etc., until the ninth and last exposure is made with the counter at No. 11. Wind off the remainder of the roll.

**Filters.** *Do not use* color filters or filters used with Kodachrome Film, in Kodacolor photography. If a color filter is used, the pictures will assume the color of the filter. *Kodak Pola-Screens* can be used with Kodacolor, as with Kodachrome, to darken blue skies for greater contrast with buildings, blossoms, etc. An exposure increase of from one to one and one-half stops is required.

**Reflectors** are valuable aids in making portraits. Any white matte surface, such as a white card or photographic blotter, is suitable, or a 20 x 30-inch piece of plywood can be coated with aluminum paint to afford a durable reflector. Correctly placed, a reflector supplements shadow illumination for improved rendering of color and detail.

## EXPOSURE

The one all-important rule to follow for best Kodacolor results is this: *Photograph subjects in Bright or Hazy Sunlight, giving exposures recommended in the instruction sheet packed with the film, in the Data Sheet in this book, or as indicated in the Snapshot Kodaguide.*

**Exposure Latitude.** Compared to black-and-white negative materials, Kodacolor Film has limited camera exposure latitude.\* For this reason, lens settings for Kodacolor pictures should always be determined carefully. Underexposure results in loss of shadow detail and in poor photographic quality, just as in black-and-white photography. Too much exposure causes highlights in the prints to become blocked up, with the result that faces lose modeling. *Both errors tend to falsify colors.*

Compared to Kodachrome Films, however, Kodacolor has somewhat greater exposure latitude. This is due largely to the fact that Kodacolor Film is a negative material, while Kodachrome is a reversal material, designed to yield positive images. With miniature Kodachrome Films, camera exposure latitude is about one stop. With Kodacolor Film, exposure latitude is about two stops; that is, satisfactory Kodacolor Prints can be made from Kodacolor negatives which received as much as a full stop more or less than the correct exposure.

## LIGHTING SUGGESTIONS

Photographers who are accustomed to making Kodachrome pictures for color printing or photomechanical reproduction will find that the same lighting principles apply with Kodacolor. The best color prints are obtained when the subject is evenly lighted and when shadows are soft, rather than dark and hard.

When dark shadows cannot be avoided, the subject should be lighted from the front, so that important details will not be obscured in shadow. In front lighting, the sun should be well to the front of the subject, but not "head-on." That is, it should strike the subject from a slight angle over the photographer's shoulder, rather than from directly over his

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\*The term *camera exposure latitude* refers to the interval between the greatest and least amounts of exposure that will produce satisfactory results.

head. When the sun is squarely in front of the subject, the face tends to have a flat, washed-out appearance.

Groups of people should not be photographed when standing partly in sunlight and partly in shade. Precautions such as this are necessary because color printing processes can accommodate only a rather limited range of subject brightness.

**Hazy Sunlight** provides an excellent opportunity for pleasing Kodacolor pictures. Shadows are soft and well lighted, and there is less tendency for subjects to squint than on bright days. In exposure tables and guides, Hazy Sunlight refers to haze sufficiently dense that the sun's disc can be viewed directly without discomfort. Under this condition, one stop more exposure is required than for bright sunlight.

### **Time of Day**

The angle of the sun is an important consideration in all outdoor photography. During the middle of the day, with the sun directly overhead, there are heavy shadows under the eyes, nose, and chin of the subject. More pleasing shadows and better modeling are obtained when the sun is lower in the sky, that is, during midmorning and midafternoon. In general, scenic and architectural subjects also photograph to best advantage with the sun at an angle.

During the two hours after sunrise and before sunset, sunlight is too orange for pictures of people with Kodacolor Film. For pictorial treatment of scenic subjects, however, the lighting effects and warmth of color obtainable at these periods may be very desirable. Such pictures require from one-half to two stops greater exposure than that recommended for bright sunlight.

### **Close-Ups**

Many of the most attractive color pictures are close-ups of individuals. When properly made, these pictures afford bold, colorful compositions that compliment both the photographer and his subject. Careful posing and lighting are essential, because the good and bad points in a close-up are equally apparent.

For close-ups taken with Kodacolor Film in bright sunlight, avoid side lighting or back lighting unless the shadow areas are illuminated by a reflecting surface or a Photoflash Lamp, as described on the next page. Note the angle of the sun, and pose the subject to obtain the best modeling and shadow effects. When you are ready to shoot, ask your subject to look away from the sun for a few minutes to rest his eyes. He cannot help squinting if he must face the sun for a long time.

### **Supplementary Lighting**

In nearly all cases, supplementary lighting will improve close-ups taken in bright sunlight. It is particularly essential when side lighting or back lighting is employed. Its object is to "fill in" shadow areas with light, and thus soften harsh facial shadows.

Natural surroundings often afford a satisfactory light-reflecting surface. In winter, snow-covered ground makes other reflectors unnecessary. In summer, a sidewalk, a white wall, or the light-colored sand on a beach may provide adequate shadow illumination. Colored reflecting surfaces must be avoided, because their color will affect the rendering of shadow areas. In the absence of natural reflecting surfaces, "fill-in" illumination can be obtained with special reflectors, or by means of synchronized Photoflash exposures.

A large white card, photographic blotter, or even a newspaper is a suitable reflector. It can be placed on the ground, in the lap of the subject, or held at one side by an assistant. It must be outside the picture area and should be placed carefully to obtain the best effect.

Synchronized flash exposures with No. 22B or No. 5B Photoflash Lamps provide a second method of filling in shadows in close-ups. These lamps can be used to supplement daylight because they are coated with a blue lacquer, causing the light to approximate daylight in color quality. To avoid overexposure of flesh tones, observe exposure recommendations carefully, and do not concentrate the flash on the face of the subject. An exposure table for such pictures appears in the Data Sheet, under the heading "Supplementary Flash to Illuminate Shadows in Outdoor Subjects." Synchronizing equipment is necessary because open-flash exposures in sunlight are impractical.

Supplementary lighting techniques are recommended for close-ups only. As subject distance increases, "fill-in" illumination is less important because shadow areas are smaller and less noticeable.

### **ARTIFICIAL LIGHT**

Kodacolor Film is designed primarily for sunlight exposure, and best results will not be obtained with any form of artificial light used independently of sunlight. When it is necessary to make Kodacolor pictures indoors, only blue-bulb Photoflash Lamps (Nos. 22B and 5B) should be used. Never use regular or daylight Photofloods, or clear-bulb Photoflash Lamps, since the pictures will be orange in color.

A common fault of Kodacolor pictures by Photoflash is a rather flat and washed-out appearance in the face of the subject, caused by overexposure of flesh tones. It can be avoided by the use of lamp and reflec-

tor combinations which produce even, diffuse illumination, such as the No. 22B lamp and a Kodaflector (matte side). If the light is not evenly distributed and well diffused, the reflector should not be pointed directly at the face of the subject.

Better lighting effects are obtainable when two or more lamps are used, instead of one lamp at the camera. This is possible by means of extension flash holders. With one lamp at the camera and a second lamp higher and at an angle of about 45° to the camera axis, the exposure required is about half that for a single lamp.

For most consistent results in making Photoflash pictures with Kodacolor Film, the camera should be used on a tripod with the shutter set on "bulb," so that the entire period of the flash will be employed. When it is necessary to make synchronized flash pictures, the camera shutter must be synchronized accurately with the peak of the flash, because the light changes in both color and intensity during the flash. Inaccurate synchronization may cause variation in the color balance of the Kodacolor Prints.

### INSPECTING KODACOLOR PRINTS

Fault	Cause	To Avoid
<i>Lack of shadow detail:</i> Shadows dark, good detail in light areas.	Shaded areas underexposed due to side or back lighting.	Take pictures of front-lighted subjects or use a reflector to reflect light into shaded areas.
<i>Lack of highlight detail:</i> Faces and other light-colored areas in the print lack color and texture.	Overexposure.	Follow the exposure tables in the instruction sheet supplied with the film.
<i>Image too yellow:</i> Good shadow and highlight detail, but no blue tones and an excess of yellow tones.	Yellow filter used over the lens or clear flash or flood bulbs used.	No color filter should be used with this film. Do not use clear flash or flood bulbs.
<i>Light-patches or streaks</i>	Light leaks in camera, resulting in fog.	Have the camera checked for light leaks.
<i>Halation, around light-colored areas</i>	Camera lens dirty.	Clean the lens with Kodak Lens Cleaner and a soft lintless cloth.
<i>Image blurred</i>	Camera was moved or object was moving too fast to be stopped at shutter speed used.	Hold the camera still. Use a shutter speed fast enough to stop the motion of the object to be photographed.
<i>Fuzzy pictures</i>	Camera not focused for camera-to-subject distance at which picture was made.	Measure the camera-to-subject distance carefully. Don't guess.
<i>Long edges red-orange</i>	Film allowed to unwind, permitting light to strike film edges.	Keep the film wound tightly. Load and unload the camera in subdued light.
<i>Image too orange:</i> Good shadow and highlight detail, but all colors too orange.	Kodacolor Film was exposed to early morning or late evening sunlight.	Do not make Kodacolor pictures of people during the first two hours after sunrise and during the two hours before sunset.



## RETURN OF FILM FOR DEVELOPMENT

Detailed instructions for returning exposed Kodacolor Film appear in the instruction sheet packed with each roll. Be sure to place the film in the return carton provided, then take it to a Kodak dealer, who will send it to the Eastman Kodak Company to be developed to negatives.

## ORDERING KODACOLOR PRINTS

All Kodacolor Print orders are handled through Kodak dealers. There are two types of orders. The first is a **"Develop and Print"** order, which the customer can enter with his dealer when he returns the film for development. In this case, the customer will not see his Kodacolor negatives before they are printed, and Kodacolor Prints will therefore be made only from those negatives which, in the opinion of the operator, are of suitable quality. No discretion can be exercised over subject matter except where the negatives are out of focus, very badly framed, or were obviously exposed by accident.

The second type of Kodacolor Print order is an order for **"Prints Only,"** after the customer has seen the negatives. In this case, Kodacolor Prints will be made from all negatives submitted, except in unusual cases where the quality of the resulting print will be so unsatisfactory as to be unacceptable. Negatives which are unsatisfactory for Kodacolor Prints often produce satisfactory black-and-white prints; these can be made by the dealer.

**Selection of Kodacolor Negatives for Printing:** Negatives should be sharp and correctly exposed, with good shadow detail, but no "blocking up" of highlights. A negative showing a wide range of colors will produce a colorful print. *The color balance of a Kodacolor negative is not especially significant*, however, because differences in color balance between rolls are corrected in the making of Kodacolor Prints. For this reason, it is not possible to judge the negatives according to a "master" Kodacolor negative of a typical subject.

**Prints from Selected Areas of Negatives:** Kodacolor Prints are normally made from the entire negative area, less slight masking at the edges. For customers who desire prints from parts of Kodacolor negatives, a special cropping service is available. An extra charge is made for the first print from each cropped negative.

This service is of special interest to owners of square-format cameras, such as those making  $2\frac{1}{4} \times 2\frac{1}{4}$ -inch negatives. Cropped areas must conform to one of the smaller standard negative sizes appearing in the table in the Data Sheet. The cropped area should be indicated by attaching tape or a black paper mask to the back of the negative. The narrower dimension of the cropped area will be enlarged to the standard  $2\frac{7}{8}$ -inch width for Kodacolor Prints.

*It is absolutely essential that Kodacolor negatives should not be cut or trimmed in any way to indicate cropping.* If this is done, the key which is punched along one edge of the negative may be lost. This key is needed when Kodacolor Prints are made, to assure satisfactory color balance.

**Matched Prints:** Prints from a given negative, ordered at different times, may not be identical. If matched prints are desired, they should be ordered at one time.

**Mounting of Kodacolor Prints:** Kodak Rapid Mounting Cement is especially recommended for the mounting of Kodacolor Prints. *Rubber cement should not be used* because the solvent may affect the dyes. Pastes containing water or other penetrating solvents are also unsuitable.

Kodak Thermount Tissue is also recommended for mounting color prints; this material can be used at a lower temperature than regular mounting tissue. Regular dry mounting tissue is not recommended, because excessive heat in the mounting process may affect the dyes.

## KODACOLOR ROLL FILM

**General Properties:** A color film which permits the taking of color snapshots in nearly all types of roll-film cameras. The exposure and development of the film result in color negatives, called Kodacolor negatives. These negatives resemble ordinary black-and-white negatives, but contain colors complementary to the colors of the original subjects. They are intended for the making of Kodacolor Prints, obtainable upon order through a Kodak dealer. Kodacolor Prints are made to a standard width of approximately  $2\frac{1}{8}$  inches, with length proportionate to that of the negative. *Black-and-white* contact prints and enlargements can also be made from Kodacolor negatives, in the same manner as from black-and-white negatives.

### Exposure Index: *Daylight* 25

This value is recommended as a setting for meters using ASA Exposure Indexes. A setting of 20 is suggested for early meters calibrated for Weston ratings, 32 for early General Electric meters. In daylight, certain meters should be pointed downward to minimize the effect from the sky, in accordance with the manufacturer's instructions.

**Daylight Exposure Table:** Lens apertures at **1/50 sec** shutter time. For winter scenes without snow, use one lens opening larger in all cases.

LIGHTING CONDITIONS*	EXPOSURES FOR AVERAGE SUBJECTS	LIGHT-COLORED SUBJECTS	DARK-COLORED SUBJECTS
Bright, Direct Sunlight	<i>f/11</i>	Between <i>f/11</i> and <i>f/16</i>	Between <i>f/8</i> and <i>f/11</i>
Hazy Sun, Soft Shadows	<i>f/8</i>	Between <i>f/8</i> and <i>f/11</i>	<i>f/6.3</i>

\*Since Kodacolor Film is color balanced for Bright or Hazy Sunlight, best results can be expected under these lighting conditions only. Kodacolor pictures made on cloudy days or in shade require about 1/50 second at *f/4.5*, but tend to be flat and somewhat bluish.

**NOTE:** With Kodak Vigilant Juniors, Jiffy Kodaks, Brownies, and cameras with similar lens openings, snapshots should be made only with front lighting in bright, direct sunlight, and with the largest lens opening.

**Supplementary Flash to Illuminate Shadows in Outdoor Subjects:** To reduce excessive lighting contrast, blue-bulb Photoflash Lamps, Nos. 5B and 22B, provide a handy means of illuminating shadow areas with light approximating daylight in color quality. The lamps should be used in a correctly adjusted synchronizer having an efficient reflector.

With bright sunlight and a clear blue sky, a desirable lighting ratio of about three-to-one is obtained by using the No. 22B lamp at 12 feet or the No. 5B lamp at  $8\frac{1}{2}$  feet. At closer distances, a clean white handkerchief can be draped over the synchronizer reflector to maintain this ratio. The following table is based on the use of Kodacolor Film, with an exposure of 1/50 second at *f/11*.

LAMP-TO-SUBJECT DISTANCE	USE OF HANDKERCHIEF WITH 5B LAMP	USE OF HANDKERCHIEF WITH 22B LAMP
4 ft	2 thicknesses	—
6 ft	1 thickness	2 thicknesses
$8\frac{1}{2}$ ft	no handkerchief	1 thickness
12 ft	—	no handkerchief

**Photoflash Exposures Indoors:** One No. 22B Photoflash Lamp in Kodaflector (matte side)—Open Flash (set shutter for time or “bulb”).

LAMP DISTANCE	5 ft.*	7 ft.	10 ft.	14 ft.
1 No. 22B (no filter)	<i>f</i> /11	<i>f</i> /8	<i>f</i> /5.6	<i>f</i> /4

\*At this distance, use largest lens opening with Kodak Vigilant Juniors, Jiffy Kodaks, Brownies, and cameras with similar lens openings.

**Guide Exposure Numbers for Use with Kodak Synchronizers:** *Note:* For correct synchronization with the No. 5B lamp in a Kodak Junior Synchronizer, shutter times faster than 1/50 second *must not be used*.

PHOTOFASH LAMP	OPEN FLASH, 1/25 OR 1/50 SEC.	1/100 SECOND	1/200 SECOND
No. 5B	50	40	25
No. 22B	55	45	28

These guide numbers are for average-size rooms with light-colored walls and ceilings. Divide the guide number by the distance in feet from lamp to subject to determine the recommended lens opening or *f*-number.

### Sizes of Kodacolor Negatives and Prints, and Exposures Per Roll:

As indicated in the following table, the negative size determines both the print size and the maximum number of exposures per roll.

KODACOLOR ROLL NUMBER	NEGATIVE SIZE IN INCHES	MAXIMUM NUMBER OF EXPO- SURES	PRINT SIZE* IN INCHES	KODACOLOR ROLL NUMBER	NEGATIVE SIZE IN INCHES	MAXIMUM NUMBER OF EXPO- SURES	PRINT SIZE* IN INCHES
C127	1 $\frac{5}{8}$ x 2 $\frac{1}{2}$	6	2 $\frac{7}{8}$ x 4 $\frac{1}{2}$	C120 or C620	2 $\frac{1}{4}$ x 3 $\frac{1}{4}$	6	2 $\frac{7}{8}$ x 4 $\frac{3}{8}$
					2 $\frac{1}{4}$ x 2 $\frac{1}{4}$	9	2 $\frac{7}{8}$ x 2 $\frac{7}{8}$
					2 $\frac{1}{4}$ x 1 $\frac{5}{8}$	12	2 $\frac{7}{8}$ x 4
	1 $\frac{5}{8}$ x 1 $\frac{5}{8}$	9	2 $\frac{7}{8}$ x 2 $\frac{7}{8}$	C116 or C616			
	1 $\frac{9}{16}$ x 1 $\frac{1}{16}$	12	2 $\frac{7}{8}$ x 3 $\frac{11}{16}$		2 $\frac{1}{2}$ x 4 $\frac{1}{4}$	6	2 $\frac{7}{8}$ x 5
C120	2 $\frac{1}{4}$ x 2 $\frac{1}{2}$	8	2 $\frac{7}{8}$ x 3 $\frac{3}{8}$	C616	2 $\frac{1}{2}$ x 2 $\frac{1}{8}$	11 or 12	2 $\frac{7}{8}$ x 3 $\frac{3}{8}$

\*All Kodacolor Prints are made to the same fixed width of 2  $\frac{7}{8}$ —the length is dependent upon the proportions of the negative. The above lengths are approximate, because of slight variations in the negative dimensions obtained with different cameras.

**CARE OF FILM, PRINTS, AND NEGATIVES:** Kodacolor Film should not be left in cameras for long periods of time. The film, prints, and negatives should be kept in a cool, dry place. The prints and negatives must be protected from prolonged exposure to bright daylight and direct sunlight. A picture album is recommended for the prints. Kodacolor Prints and negatives will not keep well in the tropics.

**Note:** Kodacolor Prints and negatives contain dyes which are as stable as possible, consistent with their other requirements. Like other dyes, they may change in time. Neither Kodacolor Film nor Kodacolor Prints will be replaced or otherwise warranted against any change in color.

KODACOLOR PRINT

KODACOLOR NEGATIVE

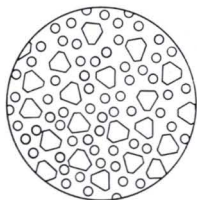


## HOW THE KODACOLOR PROCESS WORKS

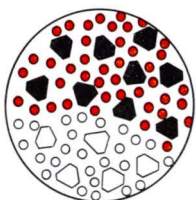
A METHOD of producing dye images in color photography is supplied by the chemical reaction known as "coupler development." In this reaction, when the developer reacts with silver bromide and forms silver, its oxidation product, as it is formed, reacts with another chemical substance known as a "coupler" and forms a color compound, that is, a dye.

In the Kodacolor Process the couplers in each emulsion layer are carried in very small globules of organic materials which are dispersed throughout the layers. The chemical basis is illustrated by the micrographic diagrams—the particles are so small that they can be seen only under a high-power microscope. These globules

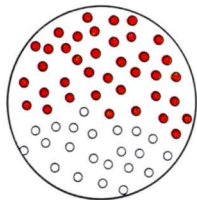
59



**Kodacolor Emulsion: Crystals of Silver Bromide and Globules of Coupler Dispersed in Gelatin.**



**Kodacolor Emulsion (Magenta Layer) after Development Showing Dye Image and Silver Image.**

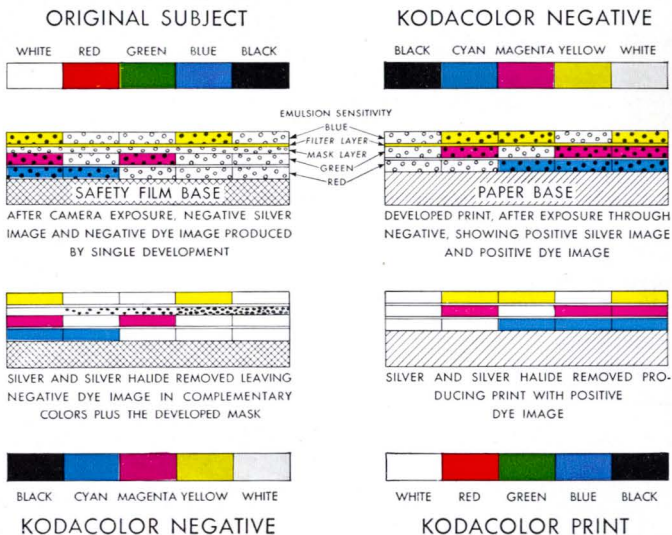


**Kodacolor Emulsion (Magenta Layer) after Removal of Silver and Silver Bromide.**

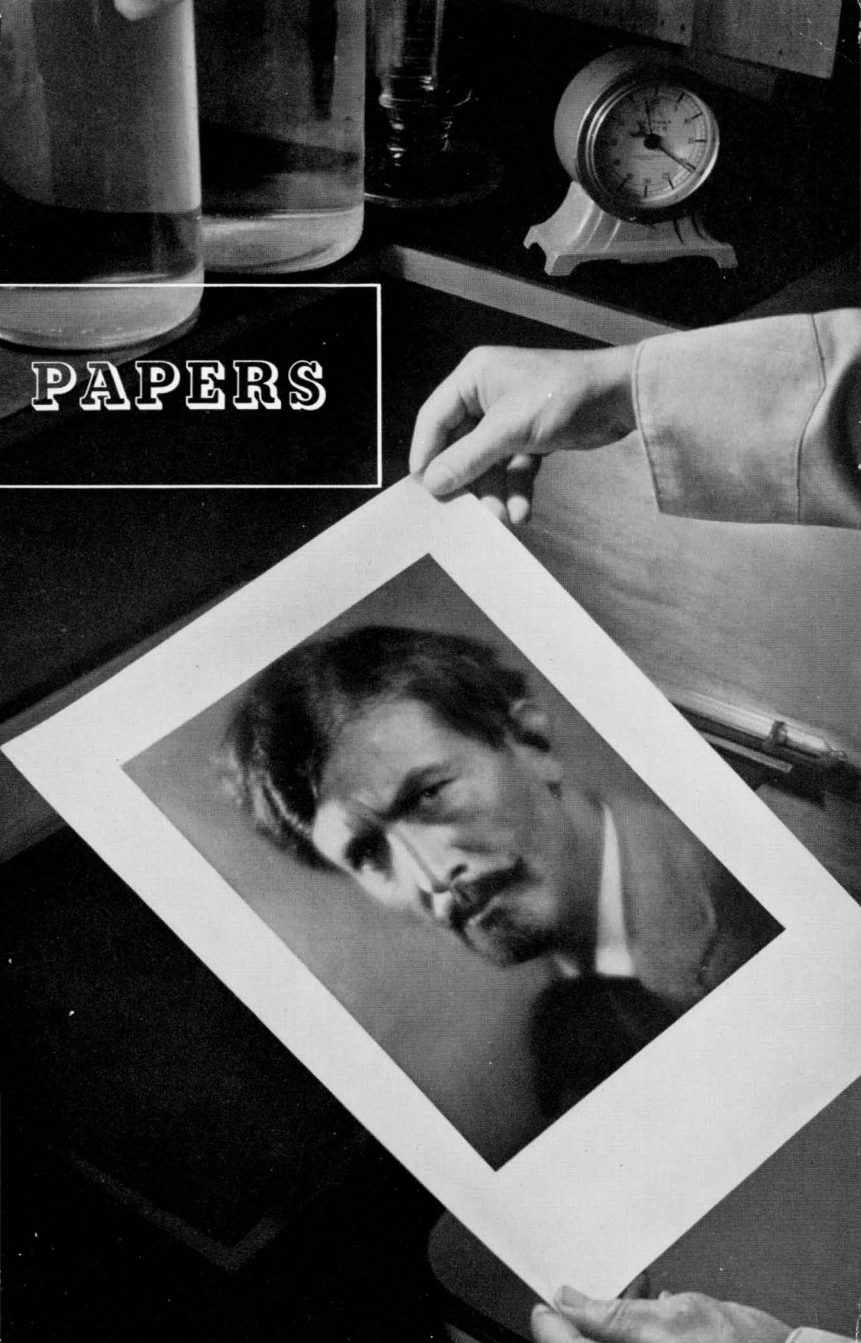
protect the couplers from the gelatin and at the same time protect the silver bromide from any interaction with the couplers. This process might be known technically as the "protected coupler process." When a suitable developer is used, the oxidation product of the developing agent dissolves in the organic materials and there reacts with the coupler, so that dyes are formed in the small globules dispersed through the layers. The color of the dye depends upon the nature of the coupler.

Kodacolor Film has three light-sensitive emulsions as well as a yellow filter layer and an emulsion layer for producing a mask image. The quality of the final print is improved as a result of this mask image. The bottom emulsion responds to red light, the middle emulsion to green, and that at the surface to blue. The yellow filter layer below the top emulsion prevents blue light from reaching the middle and lower emulsions, which are sensitive to blue, as well as to green and red respectively. The layers, so thin that their total thickness scarcely exceeds that of the emulsion layer of a black-and-white film, are coated on a safety film base having an antihalation backing.

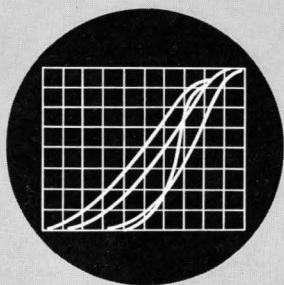
Like the Kodachrome Process, Kodacolor reproduces colors by the "subtractive" method. After exposure, Kodacolor Film is developed with a single color developer of which the oxidation product reacts simultaneously with all three couplers, each in its own layer, and thus produces a dye image along with a silver image in each layer. A cyan image is formed on the bottom layer, a magenta in the middle layer, and a yellow image in the top layer. In subsequent developing steps the silver is removed from the color layers, and a negative silver image of the dyes in the two lower layers is formed in the mask layer. The final dye image is not only negative as regards light and shade but also contains colors which are complementary to those of the original subject. When such a negative is printed upon a paper having a set of similar emulsions (excepting the mask) and requiring similar developing, a color print is obtained in which the colors of the original subject are reproduced. The reproduction of colored subjects by the Kodacolor Process is shown diagrammatically below.



# PAPERS







# KODAK PAPERS

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**THIRD EDITION, 1946—Second Printing**



DATA SHEETS

**Contrast**

**Effects  
of Variations  
in Development**

**Speed  
Values**

**Image  
Tone**

**Choice of Paper  
Surface, Tint,  
and Contrast**

**Contact Printing**

**Enlarging**

**Processing**

**Special  
Purpose  
Papers**

**AZO**

**VELOX**

**KODABROMIDE**

**PROJECTION**

**OPAL**

**ROYAL  
BROMIDE**



# KODAK PAPERS

THE object of most photographic work is to produce a print of good quality. This involves two things: selection of the proper negative, and the photographer's personal interpretation of the subject through the printing procedure. A good negative is obtained by correct exposure and development. A print of high quality will result only if an appropriate printing paper is used, and if care is taken to expose and develop it so that full advantage is taken of its ability to give that quality for which it was designed.

The manufacturer of photographic printing papers aims to produce materials which will give good prints from negatives of varying characteristics, and which will permit a wide range of quality to be attained in the final results. This is necessary because there are many different purposes for which prints are made, and because there is much variety in the personal tastes of photographers.

The following pages are intended to guide the photographer in the proper choice and use of papers for contact printing and enlarging, and in this manner to assist him in obtaining the best results that his negatives will yield. The characteristics and purposes of Kodak Photographic Papers and the recommended methods of handling these papers are described in detail. Kodak Papers are noted for their quality, uniformity, and ease of manipulation, factors which aid the user in producing consistently good prints.

# CHARACTERISTICS OF KODAK PAPERS

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PHOTOGRAPHIC printing papers differ in a great many respects. A knowledge of these differences and the reasons for them will greatly assist in the intelligent choice and use of a photographic paper. Among the more important properties are (1) contrast, the factor which fits the paper to the contrast of the negative, and (2) relative speed, which fits the paper to the printing method or equipment. The choice of tone of the image, and surface and tint of the paper stock depend largely on the subject matter and the intended use of the print.

Contrast and its related aspects are considered here under the general heading of Photographic Characteristics. Relative speed, another photographic characteristic, depends largely on the type of the emulsion. For this reason a discussion of the nature of the light-sensitive emulsions also is included here. Surface texture, paper tint, tone of the image, and so forth, are treated as Physical Characteristics. These distinctions will lead perhaps to a clearer conception of the properties of Kodak Photographic Papers.

## THE NATURE OF PHOTOGRAPHIC PAPER EMULSIONS

THE light-sensitive emulsion, generally speaking, is a light-sensitive silver salt suspended in gelatin. The chemical composition of the silver salt, the method of its formation, and the addition of special agents determine such photographic qualities as speed, contrast, and tone of the image. Photographic papers may be considered as representing three general types. Mention of the type of paper so classified is frequently required on the entry blank used in submitting prints to photographic salons.

**Chloride papers** have emulsions which consist principally of silver chloride in gelatin. These papers have comparatively low speed and are intended for contact printing. Among Kodak chloride papers are included Azo, Ad-Type, Velox, and Professional Azo.

**Bromide papers** are coated with silver bromide emulsions. As a result of their high speed they have been used generally for enlarging, but are now being replaced largely by "chloro-bromide" papers.

**Chloro-bromide papers** have emulsions containing both silver chloride and silver bromide as principal ingredients. The speeds of these papers vary over a wide range, depending largely on the proportions of silver bromide to silver chloride. In the emulsions of the faster papers, such as Kodabromide, the silver bromide predominates; while in the slower

ones, such as Vitava Opal, there is a larger proportion of silver chloride.

Some papers of this type, such as Vitava Opal, permit wide variation in the warmth of the image tone, and give more pleasing rendering in the shadow tones than bromide papers.

## **PURPOSE OF KODAK PAPERS**

PAPER CHARACTERISTICS are summarized briefly here, listed with respect to the methods used in printing.

### **Contact Printing—**

#### **With Negatives Varying in Contrast**

VELOX: Six contrast grades, two surfaces, blue-black image.

AZO: Six contrasts, two surfaces, rich black image.

PROFESSIONAL AZO: Two to four contrasts, nine surfaces, warm black image.

#### **With Negatives of Uniform Contrast**

VITAVA OPAL: One contrast, fourteen surfaces, warm black image.

### **Enlarging—**

#### **With Negatives Varying in Contrast**

KODABROMIDE: High speed, five contrasts, five surfaces, rich black image.

VITAVA PROJECTION: Medium speed, two contrasts, three surfaces, warm black image.

ROYAL BROMIDE: Extreme speed, four contrasts, one surface, blue-black image.

#### **With Negatives of Uniform Contrast**

VITAVA OPAL: Low speed, one contrast, fourteen surfaces, warm black image.

## Photographic Characteristics of Printing Papers

### CONTRAST

CONTRAST is a property of a printing paper with which the photographer is especially concerned. Contrast involves two factors: *density range* and *exposure scale*.

**Density Range** is the range of reflection densities\* from clear unexposed areas to the deepest black which the paper will produce. Since the print is viewed by reflected light, the density in the highlights is practically that of the clear paper, while the density of the deepest possible shadows is limited by the light reflected from the surface of the developed silver particles and the gelatin. The density range varies also with the surface texture of the paper, and to a lesser extent with the emulsion type.

Maximum density of glossy papers such as Azo F is about 1.70. For smooth and fine-grained lustre surfaces, such as Kodabromide N and E, the value is about 1.50. The matte-surface papers have maximum density values between 1.30 and 1.20. Density range affects visual contrast of a print. For example, if the same negative is printed on both glossy and matte papers, chosen to have the same exposure scale, the glossy print appears more contrasty even though both papers are exactly suited to the negative. Thus, the higher the density range of photographic paper—other things being equal—the more contrasty is the appearance of the print.

**Exposure Scale** must not be confused with the speed or exposure time required, but relates to the range of light intensities required to produce a print having the full range of useful tones from white to black. For example, in the case of Velox 0, if a light intensity of 1 produces a just noticeable effect, then a light intensity 30 times as great is required to produce a full black. The exposure scale values given in the Data Sheets are based on gradient or slope measurements on the characteristic curves and indicate the exposure interval between one point on the low or highlight end of the curve and another point on the shoulder or shadow end of the curve. This interval is related to the range of light intensities transmitted by the significant parts of the appropriate negative.\*\*

The essential difference between contrast grades of the same paper is

---

\*The term "reflection density" is explained in "Characteristic Curves."

\*\*For a discussion of methods of determining exposure scale, see "Control of Photographic Printing by Measured Characteristics of the Negative," L. A. Jones and C. N. Nelson, *Journal of the Optical Society of America*. October 1942, page 558.

one of exposure scale. The higher the contrast of the paper, the lower the exposure scale. For different surfaces of the same contrast grade of a given paper, exposure scale is essentially the same, e.g., the value for Azo No. 2 applies equally well to Azo E or F, No. 2.

**Paper Contrast Grades Available:** As mentioned before, the difference between contrast grades is essentially one of exposure scale.

Azo, Velox, Projection, and Kodabromide are supplied in several contrast grades to fit negatives which differ in contrast. Such differences may be due to variations in subject, lighting, exposure, or development. Other papers, such as Vitava Opal, Projection, and Professional Azo, are intended for use with negatives of uniform quality made under more carefully controlled conditions of lighting, exposure, and development, and for this reason are supplied in fewer contrast grades. The various paper contrast grades are listed in the Data Sheets.

### **Effects on Contrast of Variations in Development**

THE contrast of photographic papers is, for most practical purposes, inherent in the emulsion and the paper surface; hence it can be controlled only within narrow limits by variations in development time or developer composition.

**Development Time:** The effect of different development times on the contrast of different papers will be of interest to many photographers and darkroom operators. In the curves which follow, samples of each paper tested were exposed to tungsten light at 2800°K. for four seconds, and developed for the times marked on the curves. Although only three specific paper types are charted, each is representative of the other similar papers, as indicated in the captions.

The extremely long development times given on the curves should not be used unless processing conditions are ideal. This assumes that the solutions are fresh and that there is no danger of safelight fog.

The principal effect of increased development time with a chloride printing paper such as Azo or Velox is to give the appearance of increased exposure, or greater over-all print density, rather than increased contrast. The contrast of a chloro-bromide paper can be varied through a somewhat wider range. Even in the latter case, the contrast variation is much less than that which can be obtained by varying the development time of a negative material.

The behavior of Velox is similar to that of Azo. Likewise, the behavior of Vitava Projection and Illustrators' Special is similar to that of Vitava

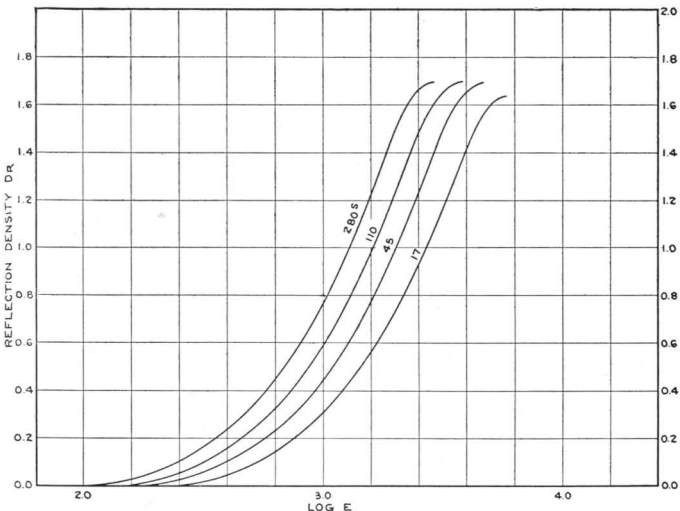
Opal in the growth of density and contrast with longer development.

For best results, a paper of suitable contrast should be chosen to fit the negative and should be exposed for proper density when developed for the recommended time.

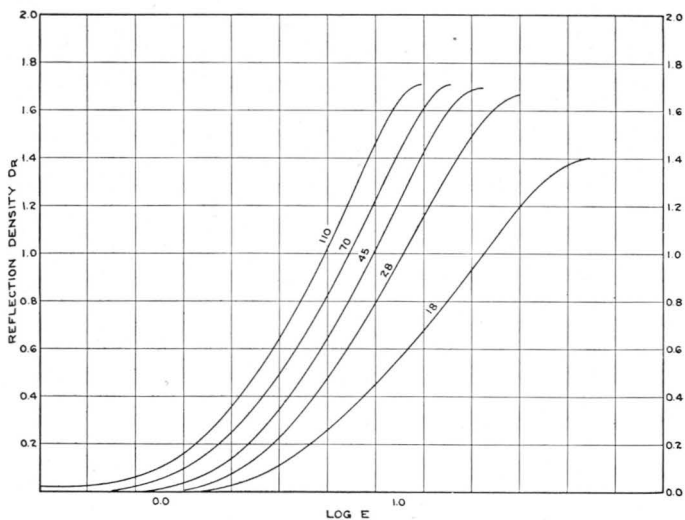
**Developer Composition:** Slight changes in the contrast of a chloride paper can be obtained by adjusting the developer composition. Slightly greater control of contrast is possible with chloro-bromide papers. With the latter, however, the principal change produced by adjusting the composition of the developer is a change in the color or "tone" of the image.

### Contrast and Enlarger Illumination

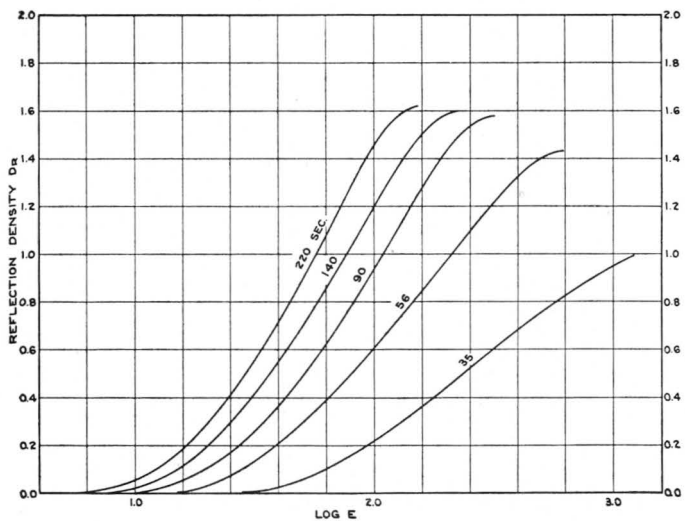
ENLARGERS equipped with condensing lenses produce prints of higher contrast than enlargers with diffuse illumination, other factors being equal. In general, the degree of contrast obtained with completely diffuse illumination is of the order of that obtained in contact printing. Effects on contrast by such variations often amount to the difference between adjacent contrast grades of paper.



Sensitometric curves for different development times for chloride emulsions of the Azo type



Sensitometric curves for different development times for chloro-bromide emulsions of the Kodabromide type



Sensitometric curves for different development times for chloro-bromide emulsions of the Vitava Opal type

## RELATIVE SPEED

THE speed of photographic papers is, in general, less than that of negative materials, and is so adjusted that exposures will be of convenient duration under conditions of average use. The various brands of Kodak Photographic Papers differ widely in speed, from comparatively slow contact printing papers such as Azo, Velox, and Professional Azo, through a moderately fast paper like Vitava Opal, which can be used for either contact printing or enlarging, to the fast enlarging papers such as Kodabromide and Royal Bromide.

**Relative Speed Values:** Relative speed values are of direct interest to the photographer in determining exposures when papers are used interchangeably. For example, it may be desirable to make a print on Opal after the exposure has been determined for Kodabromide for the same or a similar negative. The question of any needed change in exposure time is answered directly by the relative speed values.

Relative speed values are given in the table below and in the Data Sheets. These values may be regarded as shadow speeds. They are based on the light intensity required, with fixed exposure time, to produce the maximum useful density. This represents a change from the older method of determining speed values of Kodak Papers which was based on exposures in the low part, or highlight portion, of the curve. The values can be applied to the average range of exposure time to the illumination of long-life tungsten printing lamps. The relations between these values may not hold for tungsten lamps of other efficiencies and probably will not hold for other illuminants.

<i>Paper</i>	<i>Relative Speed Value</i>
Azo, Ad-Type	2.5
Velox	6
Velox Rapid	23
Vitava Opal, Illustrators' Special	125
Portrait Proof	180
Vitava Projection	240
Kodabromide	400
Royal Bromide	1,000

The question of paper speeds is complicated by a great many factors so that published speeds cannot be regarded as absolute values. For individual problems, speed values should be computed by the user by careful trial.



Since no one system of deriving such values is in general use, the data given here on relative speeds and scale values are not necessarily comparable with similar values published elsewhere.

**Printing Speed and Lamp Voltage:** When an incandescent lamp is burned below its rated voltage, both the total illumination and the proportion of blue-violet radiation are greatly reduced. This results in a lower photographic effectiveness often interpreted as lower paper sensitivity. In some cases, a drop of 5 volts may require as much as 30% increase over normal exposure time. It is recommended that the correct line-voltage be ascertained (from the local power company) and that a lamp of next lower voltage rating be used. This assumes that the lead wire from the fuse box is large enough to carry the load with no appreciable voltage drop.

### **EXPOSURE LATITUDE**

EXPOSURE latitude is the interval between the greatest and the least printing exposure times which produce satisfactory results, the development time being varied for compensation. As already mentioned, the best possible prints are obtained by exposing so that development takes place in the recommended time. Acceptable prints, however, may be obtained throughout a reasonable exposure range. Throughout the exposure and development latitude of Velox and Kodabromide, for which both are noted, there is practically no change of image tone. Warm-tone papers such as Opal grow progressively colder with increased development.

### **COLOR SENSITIVITY**

COLOR sensitivity of photographic papers for general use lies in the ultraviolet, violet, blue, and blue-green portions of the spectrum. Safelight recommendations for various Kodak papers will be found in the Data Sheets for these papers.

### **CHARACTERISTIC CURVES**

CHARACTERISTIC curves have been included for those interested in the technology of photographic printing. These curves give information with regard to tone rendering, and also on the fundamental differences between the contrast grades. The curves were obtained by exposing the paper to a scale of light intensities followed by proper development, and by measuring and plotting the resulting density against their exposure values. Density measurement is carried out by an instrument known as a densitometer. In the case of paper, *reflection* density is

measured. This is done by illuminating the paper at 45° to the normal and viewing it along the normal by the densitometer. The reflection density value of a sample is taken as:

$$\text{Logarithm} \frac{(\text{Reflection factor of clear paper})}{(\text{Reflection factor of sample})}$$

Thus zero density is the density of the undeveloped but fixed-out paper.

These curves and the values quoted for exposure scale and relative speeds apply to the average of the product designated as exposed and processed under conditions which closely approximate average practice. When results of high precision are required, a calibration of the material being used should be made under actual working conditions.

## Physical Characteristics

AMONG those characteristics here termed "physical," those of most importance are the image tone, the surface texture, tint, and weight or thickness of the paper stock.

**Image Tone** refers to the color of the silver deposit in the finished print. If brownish, the print is said to be "warm" in tone, and if blue-black, it is described as "cold." These differences in color are caused by variations in size and condition of the silver grains which form the image, and are controlled by the emulsion composition and the conditions of development. Velox normally develops to a cold, blue-black image, while Azo, Professional Azo, and Vitava Opal papers are progressively warmer in respect to image tone.

Kodak papers are here listed according to increasingly warmer tone:

COLD TONE (blue-black to black)	{ Velox Royal Bromide Kodabromide Azo E, F (Kodak Dektol, D-72) Ad-Type
SLIGHTLY WARM BLACK	Vitava Projection
WARM TONE	Vitava Opal and Professional Azo

With some papers, notably Professional Azo, Vitava Opal, and Vitava Projection, warmth of tone can be varied considerably by changes in the developer. Kodak Dektol and D-72 produce comparatively cold tones, while Kodak Selectol and D-52 yield increasingly warmer tones as potassium bromide is added and exposure is increased so that development is complete in the normal time. In general, the



**EIGHT BELLS**—Pictorial subjects in low key can be printed effectively on rough-surfaced papers.

slower the paper, the greater is its response to such treatment. Attempts to secure warm tones with cold-tone papers by overexposure and under-development lead to prints of poor quality.

Since warm tones are due to extremely small size of the silver grains in the image, prolonged fixation destroys the warmth of tone even before it produces noticeable fading. Prints which are very warm in tone should be fixed not longer than ten minutes in a fresh bath. Therefore, in order to insure complete fixation, they must be kept separated and in motion in the fixing bath.

**Surfaces** of Kodak papers differ in two general respects:

**1. Texture**, or roughness of surface—Kodak papers are classified as Smooth, Fine-Grained (slightly pebbled), and Rough. In addition, there are special textures such as, Silk, Tweed, Tapestry, and Suede.

**2. Brilliance**, or surface sheen—in this respect Kodak papers are designated as, Glossy, Lustre, and Matte.

**Paper Stock** is described in terms of:

**1. Thickness:** Depending on thickness of paper stock, Kodak papers are classified as Single or Double Weight. Single Weight paper is satisfactory for small prints. Double Weight paper is preferable for larger prints. Some papers are furnished in Light Weight or Extra Light Weight for special purposes.

**2. Tint:** Kodak photographic papers are furnished in three tints, White, Cream White, and Old Ivory.

**Baryta Coating** is a sizing layer of barium sulfate in gelatin; it is applied to the paper stock to form a foundation for the emulsion, and to increase the reflecting power of the paper. All Kodak papers have this baryta coating except those identified by the letters A, XA, and SA. These papers are intended for purposes which frequently involve folding and mailing. Elimination of the baryta coating, permits these papers to be folded with little danger of cracking.

**Duo-Coated Papers** carry the same emulsion on both sides of a special white stock, and are designated by Double Letters such as NN and SAA. These papers are intended for the production of final prints on both sides of pages for records, catalogs, and portfolios. The use of duo-coated materials helps keep related illustrations together, eliminates mounting operations, and reduces bulk.

# PRINTING FOR QUALITY

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“QUALITY” here refers to the degree of technical excellence of the final print. Only a good negative can yield a technically good print, reproducing—within the limits of an image reflected from paper—the brightness range and scale of the original subject. Here, a good negative is assumed as a necessary means to an end. Print quality is affected by technical as well as esthetic factors, and proficiency in printing can be attained only through experience.

## *Choice of Paper Surface and Tint*

THIS selection is governed by personal taste and the intended use of the print. The paper should harmonize with the subject and contribute to the desired final effect. Examination of prints in leading photographic salons, and in the Print Quality Kodaguide for Kodabromide, will assist materially in the choice of paper surface and tint.

### **SURFACE**

**Texture**, or surface roughness, largely determines the fineness of detail registered in the print—the smoother the surface, the finer the detail.

**1. Smooth** paper has no noticeable surface pattern to interfere with the rendition of fine detail.

**2. Fine-Grained** paper has a slightly pebbled surface which adds richness to a print without much loss of definition. It is generally satisfactory for exhibition prints, views, and portraits of young people.

**3. Rough** paper has a noticeable texture which tends to subdue fine detail, emphasizing the larger masses and planes of the subject. It is often useful for character studies, portraits of elderly people, and landscapes not dependent upon fine detail for interest.

**Brilliance**, or surface sheen, largely determines print brightness range—the glossier the surface, the blacker the maximum density, and the greater the possible range of tones in the print.

**1. Glossy** (Smooth) paper exhibits maximum tone range and fineness of detail. It should be used for prints intended for reproduction and for those in which extremely fine detail is important.

**2. Lustre** surfaces, with a somewhat shorter tone range than Glossy papers, are richer and more pleasing for exhibition and general use.

**3. Matte** surfaces have the shortest brightness range and subdue the over-all contrast of the subject. This is often desirable with high-key pictures and “atmospheric” landscapes.

## SPECIAL SURFACES

1. **Silk** paper, with a clothlike, glossy texture, is effective for some portraits, still-lives, and many snow and water scenes.

2. **Tweed** paper, with a very rough, lustre surface, is recommended only for subjects requiring great subordination of detail. Imparting restraint and dignity, it is most effective in large print sizes.

3. **Tapestry** paper has an extremely rough, lustre surface, which greatly subordinates detail, for large prints and massive subjects only.

4. **Suede** paper has a smooth, absolutely matte surface. Its short brightness scale suits many high and low-key pictures, portraits, and pictorials. Framed without glass, such paper shows no surface reflection, even against a strong light.

## TINT

**White** should always be used for cold-tone subjects, unless there is good reason for choosing a tinted stock. It is recommended for snow scenes and seascapes, high-key subjects, and for prints to be toned blue.

**Cream white** is probably the best choice for general use. It is suitable for both sunlit and artificially lighted scenes.

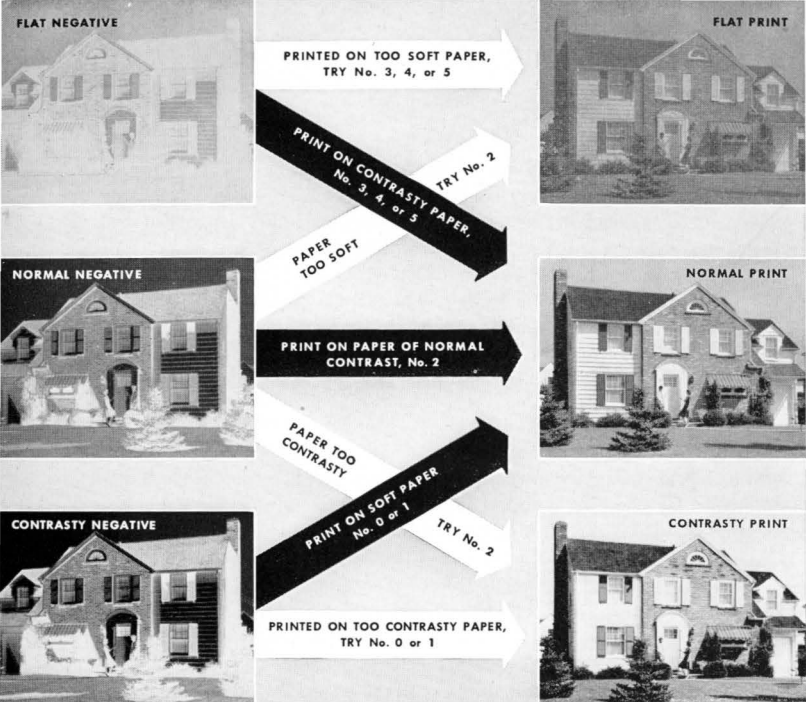
**Old ivory** is buff in color. It is effective in giving warmth and sunniness to all subjects. It adds richness to sunsets, scenes suggesting lamp-light or firelight, character studies of elderly people, etc.

It is suggested that beginners adopt a single paper surface for general use, such as Kodabromide G for enlarging and Azo or Velox E for contact printing, all with a wide range of contrast grades.

### ***Choice of Paper Contrast Grade***

CORRECT choice of paper contrast is essential to good print quality. It involves selecting a paper with exposure scale suitable for the density range and contrast of the negative, factors usually judged by inspection rather than actual measurement. Uniform development of all negatives does not necessarily suit them to a single paper contrast grade, as subject and lighting contrast also affect paper choice.

Ability to judge the required contrast grade can be gained by systematic trial and careful observation. By printing various negatives on all contrast grades of Azo, Velox, or Kodabromide, the effect of paper contrast on print quality can be observed. The muddy appearance of too soft a paper, and the harsh effect of too contrasty a paper, can be compared with the best print of each series. It is also helpful to file negatives with a note of the paper found to give the most satisfactory print. Further aid will be found in careful comparison of each good print



Selecting Paper of Proper Contrast Grade

and the negative with respect to density differences between highlight and shadow. One will learn then to select the correct contrast grade of paper by examining the negative. Negatives for salon prints preferably should be exposed and developed to fit a paper of normal contrast, such as Vitava Opal or Kodabromide No. 2.

A print made on paper of wrong contrast may seem passable until it is compared with one of correct contrast made from the same negative. As an aid in selecting the correct paper contrast, decide which of the illustrated negatives most nearly matches the contrast of the one to be printed. The directions in the black arrow leading from that negative should be followed. Thus, a normal negative should be printed on No. 2 paper. The proper choice of paper contrast makes it possible to compensate for high or low negative contrast, while the use of the wrong paper contrast results in prints that are too gray and flat or too harsh and contrasty. In judging a wet print, it should be remembered that prints dry slightly flatter and apparently darker than they

seem when wet. This effect should be allowed for, or the prints can be blotted and dried quickly with a fan.

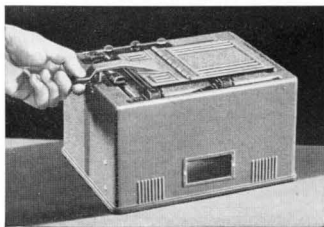
Faulty contrast can be corrected by following the instructions in the white arrow connecting the illustrations most similar to that print and the negative from which it was made.

### **Checking Darkroom Illumination**

Fog or veiling in a print degrades highlight quality and may be caused by stray white light or incorrect safelighting. The presence of stray light can be tested by leaving a strip of Kodabromide No. 1 on the paper board for 15 minutes with all safelights off. Development in a fresh developer for the normal time shows whether the margins covered by the paper holder appear lighter than the rest. Then, if no fog results, the safelight can be tested thus: Different sections of a strip of Kodabromide are exposed 2 minutes, 1 minute, 30 seconds, and no exposure on the working space below the safelight. After development, if any of the exposure steps are discernible, check the condition and distance of the safelight, and the wattage of the bulb.

## **CONTACT PRINTING**

Azo or Velox paper, with several contrast grades, is recommended for negatives of various contrasts, and Vitava Opal for negatives of uniformly normal contrast. The Kodak All-Metal Printer, shown below, or the Kodak Auto-Mask Printing Frame, provides a convenient means of contact printing. Suitable paper surface and contrast grade should be chosen as described on pages 14 to 16. The printing glass should be thoroughly cleaned and all dust carefully removed from negative as well as glass with a camel's-hair brush or Kodak Photo Chamois before printing. The masking blades of the printer are adjusted to provide white margins, or masks are cut from Kodak Mask Charts and placed over the negative. Exposure can be determined, and contrast checked, by exposing a small strip of the chosen paper for the estimated time,



processing it, and inspecting the results. Exposure should be so adjusted that the image develops to the proper density in approximately the recommended time at 68°F. The negative should be in good contact with the paper, and illumination should be uniform over the printing area.



## ENLARGING

### Cleaning the Enlarger

Dust and fingerprints on the enlarger lens degrade image contrast and print quality. Dust on negative or negative carrier glass produces spotty enlargements. Absolute cleanliness is a necessity for best results. Glass surfaces should be dusted with a camel's-hair brush and cleaned with Kodak Lens Cleaner. Loose dust should be carefully blown or brushed from negative and carrier glasses with a camel's-hair brush or Kodak Photo Chamois before insertion in the enlarger.

### Importance of Negative Masks

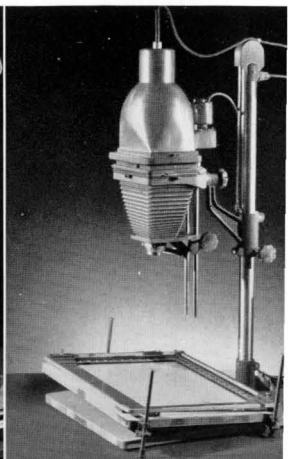
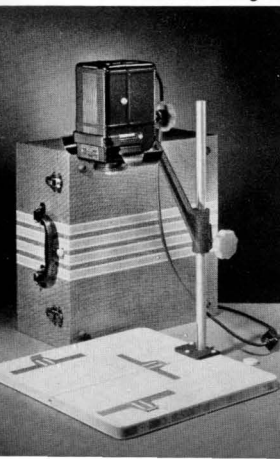
STRAY light should not be permitted to pass the edges of a negative in the enlarger, because it produces veiled print highlights. Many enlargers are fitted with masks to cut off this light. When situated at the negative plane, these can also be used to produce sharp white margins. With other enlargers, adjustable masks, Kodak Ruby Printing Masks, and masks cut from Ruby Kodaloid or Kodak Mask Charts should be used for this purpose.

### Enlarging Lens and Print Quality

A POOR enlarger lens can nullify the benefits of a good camera lens by producing prints with poor over-all definition or a falling off in definition at the corners. Use of an enlarger lens of inadequate focal length and covering power also results in poor print definition at the corners. It is desirable, therefore, to use projection lenses of good quality and adequate focal length for best enlarging results.

Left: The Kodak Portable Miniature Enlarger, with accessory Carryall Case, for 35mm and Bantam negatives. Center: The Kodak Precision Enlarger A, with Masking Paper Board, for negatives up to  $2\frac{1}{4} \times 3\frac{3}{4}$  inches. Right: The Kodak Precision Enlarger B, with Masking Paper Board and Tilting Legs, for negatives up to  $4 \times 5\frac{1}{2}$  inches.

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## ENLARGER SURROUNDINGS

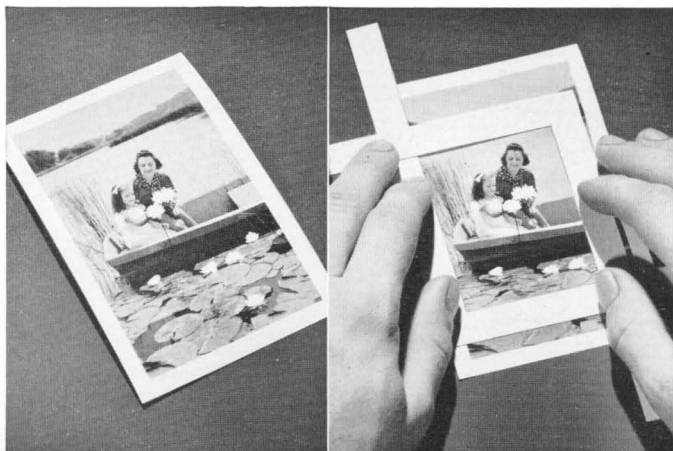
LIGHT from the enlarger image or lamphouse is sometimes reflected from light-colored walls or clothing and may fog fast photographic papers uncovered in the darkroom. This can be corrected by using Kodak Panchromatic Green Paint, or other means of reducing wall reflection, and by wearing a dark-colored apron, such as the Kodak Darkroom Apron. The enlarger lamphouse should always be properly positioned, and the lamp should be turned off when the negative carrier is removed.

## CROPPING

ONE of the most important advantages of enlarging is the fact that it permits masking or cropping the negative and enlargement of the desired portion. By this means it is frequently possible to eliminate unwanted material around the margins of the picture or to improve materially its general composition.

A contact print from the entire negative is very useful in determining what pictures are worth enlarging and in showing the effect that can be obtained in the enlargement. Often, as in the illustration below, the principal subject is surrounded by undesirable objects, which were either unnoticed or unavoidable at the time the picture was taken.

By masking off the margins of the picture with two cardboard "L's" as shown below, the part deserving enlargement can be determined. This area can be outlined on the print or marked on the print margins with an Eastman Negative Pencil. In enlarging, magnification is so adjusted that this area fills the paper. Elimination of the shore line, boat thwart, and some of the water lilies from the example below concentrates interest on the principal subjects and also results in a general improvement in composition.



## Focusing

MAXIMUM sharpness is obtained only by sharp focus and by freedom of the enlarger from vibration. Lenses of larger aperture, which provide a higher brightness level, are more easily focused than those of smaller aperture. The enlarger lens should be carefully focused while almost "wide open," and then "stopped down," usually to  $f/11$  or  $f/16$  for the exposure. Use of the Kodak Enlarging Focus Finder aids considerably in critical focusing, regardless of the lens aperture employed.

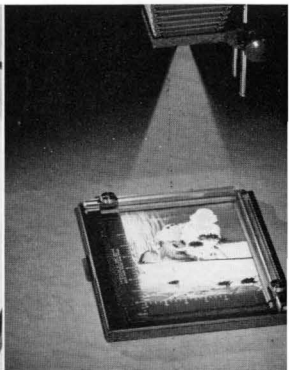
Diffusion can be produced by means of some diffusing device, such as the diffusion disks supplied for the enlarger, crumpled acetate sheeting, or sheer cloth. The lens should first be focused sharply without the diffusing device, which should then be added. The enlarger lens should *not* be thrown out of sharp focus to obtain diffusion. A sharp print is always useful as a comparison for judging the degree of diffusion suitable for a given subject.

## Exposure Determination

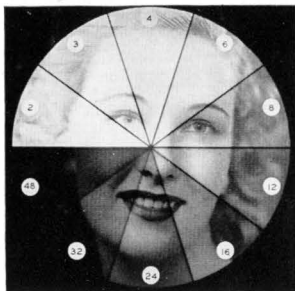
### Test Strips

AFTER the enlarger has been adjusted for an exposure, a test strip of the paper to be used is placed on the easel. Four-fifths of this strip is then covered with black paper. The strip is now given a series of exposures, for example: 32, 16, 8, 4, and 4 seconds, one-fifth more of the strip being uncovered after each exposure. In this case, the steps received 64, 32, 16, 8, and 4 seconds, respectively. The strip should then be developed exactly as recommended, immersed in the stop bath, and fixed briefly. The correctly exposed step should then be determined by inspection, paper contrast grade verified, and a full-sized sheet of paper exposed for the same time given the selected step. The experienced worker can estimate exposure with considerable accuracy, and use a 3-step test strip, with exposures:  $\frac{1}{2}$  estimated, estimated, and twice estimated. He can also recognize the need for, and apply, the dodging techniques described on page 22. See illustrations below.

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## Kodak Projection Print Scale



THE Kodak Projection Print Scale consists of a transparency with ten sectors, varying in density, each indicating a different printing time in seconds. Exposure is made through the print scale onto a piece of enlarging paper, which is then given the recommended development. The correctly exposed sector is determined by inspection, and the enlargement exposed accordingly. Full directions are included with the scale.

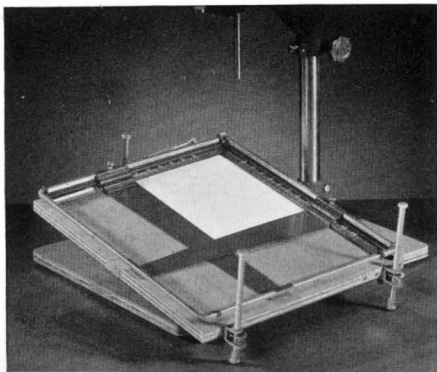
## Photometric Methods

THE Kodak Precision Enlarger is provided with a bracket to hold the Weston Exposure Meters, Models 650 and 715. The exposure meter integrates the light transmitted by the negative for calculating the required exposure. This method, instructions for which are packed with the enlarger, results in economy of paper and time. Other photometric methods can also be used to calculate enlarging exposure.

## Correcting Distortion

RESTORATION of parallelism to lines that have become distorted in a negative exposed in a tilted camera is possible when making an enlargement by tilting of the paper easel. Such a procedure will, of course, necessitate use of a smaller-than-usual lens opening to bring back into focus those negative areas made unsharp by changing of the easel plane. General practice is to set the lens diaphragm at its largest opening, focus the negative image in the center of the tilted easel, and close the diaphragm as much as is required to sharpen the out-of-focus areas. The amount of correction possible depends entirely upon the depth-of-focus capabilities of the enlarger lens.

**Set of Tilting Legs attached to the Kodak Masking Paper Board. Pressure of the spring catches permits the legs to move freely up and down. The spindles have incisions at half-inch intervals for measuring purposes.**



## Dodging

WHEN some parts of a "straight" enlargement are too dark or too light, although general exposure and contrast are correct, dodging will very often yield improved results. An area can be lightened by shading it



from the projected image during part of the normal exposure given the rest of the print. Conversely, an area can be darkened by exposing it for a longer time, after the rest of the print has received normal exposure. A paddle of wire and dark-colored cardboard, round as shown at the left, or shaped like the area to be shaded, can be used to lighten small areas. A small area can be darkened by giving it longer exposure than the rest of the print through a hole in a dark-colored card, such as that on the enlarger baseboard at the left. The dodging medium should be held 3 to 4 inches above the enlarging paper and kept moving to avoid sharp outlines. Some enlargements may require a combination of these techniques in order to lighten certain areas and darken others. Correct dodging

time can be determined with test strips after over-all exposure has been determined, and contrast checked, as described previously.

## Print Quality Requirements

THE quality required in a print depends somewhat on the purpose for which the print is made, as for viewing or copying.

Prints made for hanging on the wall of a home should be slightly lighter than prints made for mounting in an album or for exhibition, because the amount of light on the walls of a house is seldom sufficient for the proper illumination of a normal print.

Prints made for copying should be on smooth paper and should show full detail in both highlights and shadows. To achieve this, the lightest white should be slightly grayed, while the darkest black should be not quite the deepest that can be recorded by the paper. A print of this character makes it possible to preserve the whole scale of the scene in the copy negative.

In making special-effect prints, as in high-key and low-key work, the best exposure and development must be determined by trial.

## **Processing of Papers**

CORRECT processing of papers is vital to print quality and is secured by following the manufacturer's recommendations which are based on exhaustive research on the many factors which affect quality, convenience, and economy.

Development recommendations for the use of Kodak Dektol, Selectol, D-72, and D-52, appear in the Data Sheets. Other developers which can be used are Kodak Versatol (a concentrated, universal liquid developer) and Kodak Universal M-Q Developer (supplied in convenient packets). Directions for use appear on each package of developer.

### **Time of Development**

EXCELLENT prints are possible only when the printing exposure is such that proper print density is secured in approximately the recommended development time. A common cause of "muddy" prints is underdevelopment. There is a natural tendency to pull out a rapidly darkening print before development is completed, but the resultant image is poor in tone, lacking in contrast, and often is mottled from uneven development. Exposures *must* be carefully timed to suit development.

Some papers having more latitude than others require less critically timed exposure. Kodabromide Paper is particularly noted for exposure latitude, and a reasonable range of development times is possible.

Overdevelopment or long treatment in an overworked solution is likely to cause a yellow stain, due to developer oxidation products. Oxidation may also result from other causes such as exposing the developing print to air or using an exhausted fixing bath. Processing stains, even in slight degrees, degrade print quality.

### **Uniform Development**

THE developing tray should be somewhat larger than the print. This allows proper agitation and convenience in handling the prints. Kodak trays are made with this need in mind, for example, an 8 x 10-inch tray measures about 9 x 11 inches. The exposed print is slipped edgewise and face up into the developer solution so that it is covered quickly and evenly. During development, the solution should be agitated by rocking the tray or by keeping the prints in motion. The prints must be kept completely immersed during development.

### **Stop Bath**

AFTER development, the print should be immersed for at least 5 seconds in a stop bath, such as Kodak SB-1, and agitated to insure thorough access of the solution to all parts of the print. If the stop bath is made

much stronger than the Kodak SB-1 formula, or if prints are left in the stop bath longer than necessary, a mottled effect may result.

The Kodak Testing Outfit for Stop Baths and Fixing Baths provides a simple test for determining definitely when the stop bath is exhausted. The Kodak Stop Bath with Indicator, which is supplied as a prepared powder, changes color when it is neutralized and thus indicates automatically when the stop bath should be discarded.

### **Fixing**

THE print should be transferred to stop and fixing baths quickly, without any intermediate examination. After the prints have been rinsed carefully in Kodak Stop Bath SB-1, they should be fixed for about 5 to 10 minutes at 68° F (20° C) with agitation in a suitable acid hardening fixing bath such as the solution prepared from Kodak Acid Fixing Powder with Hardener or from the formula for Kodak Fixing Bath F-1. Agitation of the prints in the bath insures thorough access of the solution to all parts of the print surface.

In order to insure complete fixation, it is desirable to use two baths, treating the prints in the first for about 5 minutes, then transferring them to a fresh bath for another 5 minutes.

Prolonged fixing should be avoided, particularly with warm-tone prints, because of the tendency of the bath to bleach the image and change its tone. As a general rule, prints should not be fixed in a bath that has been used for fixing films or plates.

### **Appearance of the Print in the Fixing Bath**

THE appearance of the fixed print in the hypo tray is slightly deceptive. Upon drying, prints become somewhat darker and lose contrast, especially on matte and warm-tone papers. One method of discounting the contrast and brilliance of a wet print is to tilt the safelight away from the hypo or wash tray, so that the print is viewed by dimmer light. Its appearance should then be darker and less contrasty, corresponding more closely to the appearance of the dry print. After experience with this method, errors in flatness and overdensity will be detected easily.

### **Washing**

THE prints must be washed for at least one hour with a flow of water sufficient to change the water in the tray 10 to 12 times an hour.

The washing tray must not be loaded to the point where the prints mat together and the stream of water cannot keep them moving. The Kodak Automatic Tray Siphon is a convenient device for providing efficient circulation of the water. Prints are washed much more slowly in cold water than in warm water. If at all possible, the wash water

should be maintained at a temperature between 65° and 75° F.

When greatest permanence is desired, or when the time for washing is limited, the prints should be treated in the Hypo Eliminator HE-1, followed by the Kodak Gold Protective Solution GP-1.

### **Drying**

AFTER being washed, the prints should be placed on a clean glass or a board covered with oilcloth or linoleum so that excess water can be swabbed off with cotton or a viscose sponge. Glossy paper should be dried on ferrotype tins or drums when high gloss is desired.

Small quantities of prints which do not require ferrotyping can be dried in the Kodak Photo Blotter Roll, larger quantities in the Eastman Professional Print Dryer. Prints can also be dried on clean cheesecloth stretchers or between clean blotters. In the latter case, the drained prints should be pressed between blotters for a few minutes, then transferred to dry blotters. Kodak Blotting Paper is of special photographic quality. Ordinary blotters are too soft and linty and may contain impurities which will affect the prints.

If prints curl after drying, they can be flattened by dampening their backs with water (or equal parts of alcohol and water), then re-drying between blotters under heavy pressure for two or three hours. Kodak Print Flattening Solution can be used to prevent curling and possible cracking of the emulsion.

When prints are imperfectly washed, the drying supports become contaminated with hypo which may transfer to prints subsequently dried.

### **Toning**

THE choice of the various papers offers a selection in the warmth of tone of the print, as shown under "Physical Characteristics." Also, the warmth of tone of some papers, such as Professional Azo, Vitava Opal, and Vitava Projection, can be varied by the choice of the developer; for example, Kodak Selectol and D-52 produce warmer tones than Kodak Dektol and D-72 on such papers.

When a more definitely colored image is desired, it is usually necessary to submit the developed and fixed image to some process in which a color or tone is produced by replacement of the silver image with inorganic salts or with dyes. Toners can be obtained in packaged form, or they can be prepared from formulas. Although most toning processes are quite simple, correct exposure and development of the original print are extremely important factors and overfixing must be avoided. Small variations in tone of the original silver image may be accentuated with wide variations in the color of the toned print.



## **Print Faults**

ANY defects in the negative will be reproduced in the print or enlargement, often exaggerated to a certain extent. In addition, improper handling can produce faults in prints made from perfect negatives.

Following are listed several print faults, the causes, and the remedy.

*Blurred Image:* In enlargements; enlarger out of focus, or enlarger vibrated during exposure. In contact prints; improper contact between paper and negative because of warping of printer platen, badly fitted hinge or other part of printer, or excess thickness of margin masks. Negative may have been reversed, with its base toward the paper.

*Cracks:* In paper base or emulsion, caused by rough handling during processing or too violent agitation in washing.

*Spots:* Round white spots usually caused by air bells on the surface of the print during development. Round or irregular dark spots caused by air bells on prints, or several prints matting together, in fixing bath. Develop prints face up, and move prints about occasionally during fixing.

*Mealy, Mottled Prints:* Indicate overexposure and short development, oxidized developer, or prints not kept moving when first immersed in fixing bath. Sometimes obtained with old paper.

*Flatness:* Due to the choice of the wrong contrast grade of paper, underdevelopment, or a dirty enlarger lens.

*Fog:* Stray light at negative carrier not masked out, or safelight fog of several types.

## **STAINS**

*Brown or Red:* Result of using old or oxidized developer. Also caused by trace of hypo on prints during development or by using warm developer. Fixing bath lacked sufficient acid and prints were not kept moving to allow uniform or sufficient fixing. Insufficient washing causes stains which appear during drying, particularly if heat is used.

*Purple discoloration:* Often appearing after some time on finished print, caused by incomplete fixation.

*Yellow:* General, or yellowing whites. Forced development, too weak, too old, or too warm developer, development in dirty tray, prints rinsed too long after developing and before fixing, or prints not agitated when first immersed in fixing bath. Insufficient fixing and washing.

*Greenish tones:* Overexposure and underdevelopment, too much bromide or not enough carbonate in developer, or developer may be too old or too cold.

*White deposit on surface:* Hardener scum from old fixing bath, or precipitated on print which was not rinsed between development and fixation. Sulfur from fixing bath sulfurized by heat, excess acid or insufficient sulfite.

*Yellowish-white image, faded highlights, on old prints made on developing-out paper:* Caused by conversion of silver image to yellowish white silver sulfide, with age. Due to thiosulfates left by incomplete washing, sulfur from sulfurized fixing bath, exposure to sulfurous gases in the air, or sulfur compounds in the mount.

A faded print can often be restored by bleaching in Kodak Stain Remover S-6 and redeveloping in a non-staining developer such as Kodak Dektol or D-72, diluted 1:2.

For treatment of more difficult cases, see the article, "Stains on Negatives and Prints," obtainable from the Sales Service Division, Eastman Kodak Company, Rochester 4, N. Y.

## **Mounting**

MOUNTING involves a need for a certain amount of manual skill and good taste; an unsuitable mounting can nullify the care and judgment used in making the print.

The function of the mount is to disassociate the print from its surroundings. Such emphasis on the print itself should be accomplished appropriately and neatly without garishness of the mount.

Small prints should be mounted in albums soon after they are made, to prevent loss and to keep them in good condition. The book-type albums offer several advantages.

For salon or exhibition use, prints should usually be mounted on 16 x 20-inch card stock. This is carried by artists' supply houses in several different styles and thicknesses, one of the most popular being a pebbled stock, natural white on one side and cream white on the other. Its dual surface characteristics make it suitable for prints on either ivory or white papers.

Since most salons specify 16 x 20-inch mounts, prints for these should ordinarily be made on 14 x 17, 11 x 14, or 8 x 10-inch paper, and mounted so that the mount always can be hung vertically. If paper larger than 14 x 17 inches is used, there will not be enough border

to create a pleasing effect. Prints smaller than 8 x 10 inches are inclined to look lost unless they have unusual appeal. Sub-mounts add an illusion of magnitude to small prints.

Kodak Dry Mounting Tissue, Kodak Rapid Mounting Cement, Kodak Photo Paste, or Kodak Photopaste Powder can be used for mounting. Instructions are packed with each.

### **DRY MOUNTING WITH A FLATIRON**

THE most permanent and satisfactory method of mounting prints is by means of Kodak Dry Mounting Tissue. The tissue is "tacked" to the back of the print with a Kodak Tacking Iron or an electric flatiron. Tissue and print are trimmed to the desired size, then permanently attached to the mount by heat and pressure from the iron. For small-sized prints, this procedure is exceedingly simple. Nevertheless, the novice might encounter some difficulty in doing a neat job when mounting a salon print upon the standard 16 x 20-inch heavy mount. If a Kodak Dry Mounting Press and Kodak Tacking Iron are not available, the following procedure is recommended:

Make a flat layer of newspapers, about 25 leaves thick, upon a flat

### **28 KODAK PAPERS**

Fine-grained or smooth, lustre papers like Opal G or B are most suitable for pictures of children.



bench or table. The iron, heated to a temperature at which it just sizzles (about 230°F) when touched with a wet finger, is used to smooth out this pile. It must not be hot enough to scorch the paper. The back of the mount is then ironed all over until it curls slightly upward at the edges. The mount is turned over, and the print, bearing the trimmed tissue, is placed in the right position and held down with a paperweight in its center. After the corners of the tissue are tacked down, the weight is removed, and the whole mount covered with one smooth sheet of tissue paper and two leaves of newspaper. The layers are then ironed with steady, heavy strokes starting at the center and eventually covering the *whole mount*. The iron should never be stopped during this part of the operation, and it must be just hot enough to give the tissue proper adhesion. If too hot, the adhesive becomes temporarily soft, permitting the print to pull away from the mount. Also, the gelatin on the print is in danger of melting.

This treatment gives the mount a slight "face" curl. The mount should be turned over and ironed on the back until it has a slight "back" curl. The mount is reversed, warmed, and flattened on the print side with a few strokes of the iron, a cold board or mount is placed quickly on top of the newspapers, and pressed down for a few minutes. If a sub-mount is used, it should be mounted in this manner and the print mounted over it.

## FINISHING EXHIBITION PRINTS

OBSERVING these suggestions will improve appearance of salon prints:

1. Prints which are on white stock require white mounts and black or blue-gray sub-mounts.
2. Prints on tinted stock or with warm-toned images should be mounted upon *pale* cream or ivory mounts with black or sepia sub-mounts.
3. Sub-mounts should leave only a narrow border, about  $\frac{1}{8}$  inch, around the print and that border should have parallel edges. Light stocks should be used with dark pictures and dark stocks with high-key photographs.
4. Titling may be tastefully done with a colored pencil of the same general tone as the print. The title and signature should be small and neat. Avoid complicated line designs drawn around the print.
5. Kodak Spotting Colors are recommended. Spotting on glossy and lustre paper surfaces is less noticeable if a small amount of mucilage or glue is mixed with the spotting colors. The higher the surface gloss, the greater is the amount of mucilage required.

## PAPERS FOR SPECIAL PURPOSES

IN ADDITION to the papers already described, there are several papers and positive materials for special purposes. A brief outline of the uses and characteristics of some of these materials follows.

**Resisto N and Resisto Rapid N Papers** are made on a special water-resistant base. This base permits rapid washing and drying, and holds size during processing much better than ordinary paper base. Prints on these papers can be completely processed in 7 to 8 minutes, and dry quickly when hung freely in air. With a 7 to 8-minute processing time, dimensional changes are very small.

**Resisto N** is a contact printing paper, produced by coating an emulsion similar to Velox on the specially treated base. It requires approximately the same exposure and development as Velox paper, and is supplied with a white, lustre, smooth surface, in contrast grades 0, 2, 3, and 5.

**Resisto Rapid N** is an enlarging paper produced by coating an emulsion similar to Kodabromide on the special base. It requires approximately the same exposure and development as Kodabromide paper, and is supplied with a white, lustre, smooth surface, in contrast grades 1, 2, 3, and 4.

**Velox Rapid Paper** is designed for use with the Velox Rapid Printer or similar optical printers. It is faster than Velox, and is designed for the production of oversize prints of the same tone quality as Velox contact prints. Velox Rapid is available in five contrast grades in Single Weight, white, glossy, smooth. It is suitable for fast contact printing, but is too slow for projection purposes with standard enlargers.

**Illustrators' Special** has a full-scale, brilliant emulsion of the quality and speed of Vitava Opal. It is an excellent medium for commercial illustration and reproduction purposes, and the surface is well suited to retouching or other forms of art work. This paper can also be used for combination pictures and "paste-in" photomontages. It is supplied in both Single and Double Weight in a white, lustre, fine-grained surface and in a white, glossy, smooth surface.

**Ad-Type** is a contact printing paper having the same speed as Azo. It is designed to fold without cracking, and is an excellent medium for photographic greeting cards. Ad-Type is coated on white, lustre, smooth stock, Light Weight, and is supplied in six contrast grades, similar to Azo.

**Translite Film** is intended for making black-and-white transparencies to be viewed by transmitted light. Transparencies on Translite have a remarkable quality of roundness and depth. It is also useful for making enlarged negatives in paper negative work, and renders fine detail to a greater extent than an actual paper negative. It consists of a safety film base coated on both sides with an emulsion similar in speed and contrast to Vitava Projection Paper, No. 2. The emulsion contains a matting agent which improves the characteristics of the transparencies for viewing and for coloring, on the back, with Kodak Transparent Oil Colors.

**Portrait Proof Paper** is a rough, Single Weight paper, slightly slower than Vitava Projection. It is normally intended for making proofs from professional portrait negatives. This is a developing-out paper, not a printing-out paper. Its pleasing surface texture has made this paper relatively popular for finished work. It is also used in making photomurals. It is supplied in one surface, lustre tweed R.

**Studio Proof Paper** is a smooth, white, Single Weight printing-out proofing paper which requires sunlight or extremely brilliant artificial light for printing. It is supplied in two surfaces, glossy F and lustre N.

**Super Speed Direct Positive Paper** provides a direct positive image by chemical reversal, and is useful for making prints directly from transparencies. It can also be used in the camera. The emulsion is orthochromatic, and has a short range of exposure latitude.

**Recording Papers** are designed for many scientific and technical applications which require a fast paper of high contrast for recording steady and transient phenomena. Recording Papers are supplied in standard and special sizes for such instruments as oscillographs, electrocardiographs, etc.

**Papers for Industrial Use** are a group of sensitized materials supplied for reproducing all types of drawings, documents, records, and similar copy. These materials, which include Linagraph and Reflex Copy Papers, have wide application in the commercial and legal facsimile reproduction fields as well as in the engineering and architectural fields.

**There are other photographic papers** for specialized purposes not mentioned here. Information on specific applications of such papers, or additional information concerning those papers mentioned, is available on request from the Eastman Kodak Company, Rochester 4, N. Y.

## Data—AZO AND PROFESSIONAL AZO PAPER

**Purpose:** Azo is a contact printing paper of uniformly high quality. Professional Azo is somewhat faster and is warmer in tone. The warmth of Professional Azo makes it especially suitable for final contact prints from paper negatives.

**Tone:** Azo, E, and F are quite neutral in tone; Professional Azo Papers have a pleasing warm tone.

**Special Applications:** Because of its warm tone, Professional Azo is particularly acceptable as a portrait paper.

### Contrast Grade, Speed, and Exposure Scale Values:

<i>Contrast Grade</i>	<i>Speed</i>	<i>Exposure Scale Value</i>	<i>Type of Negative Suited</i>
0	2.5	1:40	Very Contrasty
1		1:32	Contrasty
2		1:20	Average
3		1:16	Flat
4		1: 9	Extremely Flat
5		1: 3.5	Very Thin and Flat

### Weights and Surfaces:

<i>Tint and Surface</i>	<i>Single Weight</i>	<i>Double Weight</i>	<i>Post Card</i>
White, Glossy, Smooth	F* No. 0, 1, 2, 3, 4, 5	F* No. 0, 1, 2, 3, 4, 5	F* No. 1, 2, 3, 4
White, Lustre, Fine Grained	E* No. 0, 1, 2, 3, 4, 5	E* No. 0, 1, 2, 3, 4, 5	E* No. 1, 2, 3, 4
White, Lustre, Smooth (Duo-Coated)	NN No. 2, 3		
Cream White, Lustre, Fine Grained		G No. 1, 2, 3, 5	
Cream White, Matte, Smooth		C No. 1, 2	
Cream White, Lustre, Smooth		B. No. 1, 2, 3	B No. 1, 2, 3
Cream White, Matte, Fine Grained		H No. 1, 2	
Cream White, Lustre, Silk		Y No. 1, 2, 3	
Old Ivory, Lustre, Smooth		J No. 1, 2	
Old Ivory, Lustre, Fine Grained		P No. 1, 2, 3, 5	
Old Ivory, Lustre, Silk		X No. 1, 2	

\*Azo Papers—All other surfaces are Professional Azo.

**Safelight Recommendations:** Wratten Safelight Series OO or Series OA.

**Development Recommendations:** (at 68° F—20° C)

<i>Kodak Developer</i>	<i>Dilution</i>	<i>Recommended Time</i>	<i>Useful Range</i>	<i>Purpose</i>
Dektol or D-72 Selectol or D-52	1:2 1:1	60 sec. 120 sec.	45 to 120 sec. 90 to 240 sec.	Cold Tones Warm Tones for Professional Azo

**Acid Stop Bath:** Rinse at least 5 seconds in Kodak SB-1, with agitation.

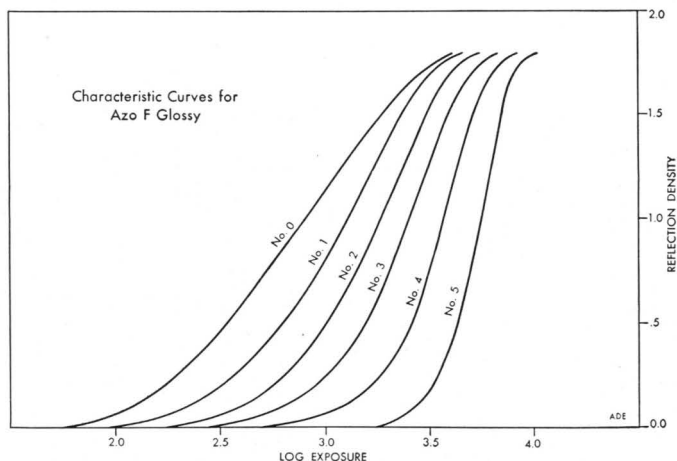
**Fixing:** 5 to 10 minutes in fresh Kodak F-1, with agitation.

**Washing:** One hour in running water, with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes.

**Drying:** Glossy prints can be ferrotyped. All other prints should be put face down on clean glass and excess water removed with a roller, sponge, or squeegee; they can then be dried in the Kodak Photo Blotter Roll, between clean photographic blotters, or face down on clean cheesecloth stretchers or an old, well-laundered sheet.

**Exposure and Development Latitude:** Azo has some latitude on the underexposure side, making possible a degree of forced development when the printing exposure has been somewhat less than necessary.

#### Characteristic Curves:



**Recommended Toners:** Kodak Selenium Toner is recommended for Professional Azo Papers and yields very good sepia prints. Kodak Gold Toner T-21 gives rich sepia tones with all surfaces. Kodak Blue Toner produces pleasing cold blue tones suitable for certain subjects on Professional Azo. Azo (E and F) can be toned in Kodak Hypo Alum Toner T-1a.



## Data—VELOX PAPER

**Purposes:** Velox is the ideal contact printing paper for making album prints. This paper has a uniform tone throughout all contrast grades. Six degrees of contrast make it ideal as a medium for making prints from a variety of negatives of different degrees of contrast.

**Tone:** Blue-black, uniform through all degrees of contrast, and equally uniform for a range of development times.

### Contrast Grade, Speed, and Exposure Scale Values:

<i>Contrast Grade</i>	<i>Speed</i>	<i>Exposure Scale Value</i>	<i>Type of Negative Suited</i>
0	6	1:32	Very Contrasty
1		1:18	Contrasty
2		1:11	Average
3		1: 8	Flat
4		1: 5	Extremely Flat
5		1: 3.5	Very Thin and Flat

**Weights and Surfaces:** F—Single Weight, white, smooth, glossy—Contrast grades Nos. 0, 1, 2, 3, 4, 5.

**Safelight Recommendations:** The Wratten Safelight Series OA is preferable for judging print depth during development, but the Wratten Series O may be used.

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Snow scenes are best printed on a white, lustre paper such as Kodabromide E or N.



**Development Recommendations:** (at 68° F—20° C)

<i>Kodak Developer</i>	<i>Dilution</i>	<i>Recommended Time</i>	<i>Useful Range</i>
Dektol or D-72	1:2	60 sec.	45 to 120 sec.

**Acid Stop Bath:** Rinse at least 5 seconds in Kodak SB-1, with agitation.

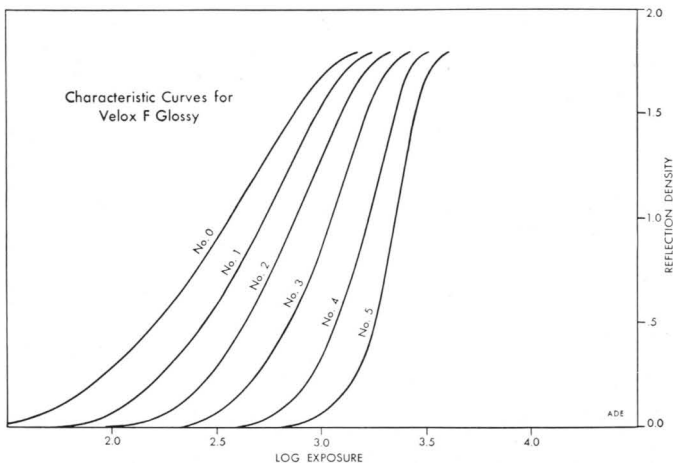
**Fixing:** 5 to 10 minutes in fresh Kodak F-1, with agitation.

**Washing:** One hour in running water with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes.

**Drying:** Glossy Velox prints can be ferrotyped.

**Exposure and Development Latitude:** When the exposure has been miscalculated and is greater than necessary, Velox stands a degree of overexposure up to 1.5 times normal very well. Velox may be removed from the developer slightly before the recommended time without great danger of mottle and attendant troubles.

**Characteristic Curves:**



**Recommended Toners:** For brilliant sepia toned prints, Kodak Sulfide Sepia Toner T-7a is recommended. Kodak Sepia Toner, prepared tubes, is also recommended.

## Data—KODABROMIDE PAPER

**Purpose:** Kodabromide is an enlarging paper well suited for the making of exhibition prints which require brilliant and rich blacks. Its speed makes its use practical with any type of enlarger. Additional features include a long-scale emulsion, five degrees of contrast, wide latitude in exposure and development, and a physically hardened emulsion, all of which make it ideal as a general-purpose enlarging paper. Kodabromide F No. 1 or N No. 1, both in Single Weight, are recommended for positives and negatives for the paper negative process. Kodabromide F is widely used for news pictures and withstands the treatment in rush handling.

**Tone:** Brilliant, rich black, uniform through all degrees of contrast and especially uniform for a wide range of development times.

### Contrast Grade, Speed, and Exposure Scale Values:

<i>Contrast Grade</i>	<i>Speed</i>	<i>Exposure Scale Value</i>	<i>Type of Negative Suited</i>
1	400	1:28	Very Contrasty
2		1:14	Average
3		1: 8	Flat
4		1: 5	Very Flat
5		1: 4	Extremely Flat

### Weights and Surfaces:

<i>Tint and Surface</i>	<i>Single Weight</i>	<i>Double Weight</i>
White, Glossy, Smooth	F No. 1, 2, 3, 4, 5	F No. 1, 2, 3, 4, 5
White, Lustre, Smooth	N No. 1, 2, 3, 4, 5	N No. 1, 2, 3, 4, 5
White, Lustre, Smooth (Duo-Coated)	NN 2, 3	
White, Lustre, Fine Grained	E No. 1, 2, 3, 4, 5	E No. 1, 2, 3, 4, 5
	<i>Light Weight</i>	
White, Lustre, Smooth	A No. 1, 2, 3, 4, 5	
Cream White, Lustre, Fine Grained		G No. 1, 2, 3, 4, 5
Old Ivory, Lustre, Fine Grained		P No. 1, 2, 3, 4, 5

**Safelight Recommendations:** Wratten Safelight Series OA.

**Development Recommendations:** (at 68° F—20° C)

<i>Kodak Developer</i>	<i>Dilution</i>	<i>Recommended Time</i>	<i>Useful Range</i>	<i>Purpose</i>
Dektolor D-72	1:2	60 sec.	45 to 120 sec.	Normal Development
Dektolor D-72	1:4*	120 sec.	90 to 240 sec.	Slower Development
Selectol or D-52	1:1	120 sec.	90 to 240 sec.	Warm Tones

\*Add  $\frac{1}{4}$  oz. (8 cc.) 10% Potassium Bromide solution to each 32 oz. (1 liter) of diluted developer.

**Acid Stop Bath:** Rinse at least 5 seconds in Kodak SB-1, with agitation.

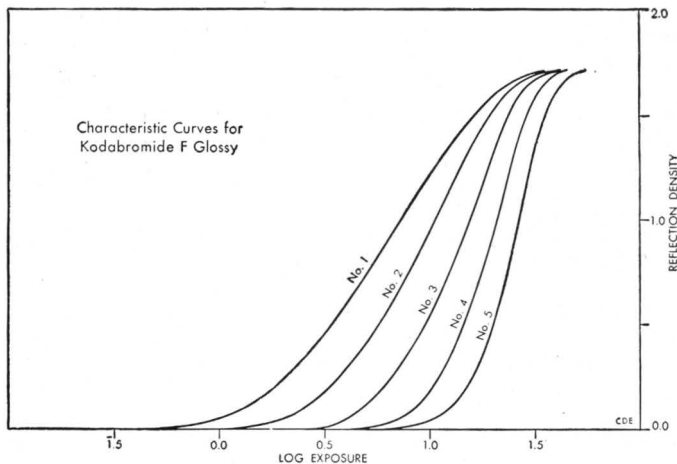
**Fixing:** 5 to 10 minutes in fresh Kodak F-1, with agitation.

**Washing:** One hour in running water, with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes.

**Drying:** Glossy prints can be ferrotyped. All other prints should be put face down on clean glass and excess water removed with a roller, sponge, or squeegee; they can then be dried in the Kodak Photo Blotter Roll, between clean photographic blotters, or face down on clean cheesecloth stretchers or an old, well-laundered sheet.

**Exposure and Development Latitude:** Kodabromide is noted for an exceptionally wide latitude both in exposure and development.

**Characteristic Curves:**



**Recommended Toners:** Beautiful sepia prints may be obtained in Kodak Sulfide Sepia Toner T-7a and Kodak Sepia Toner.

## Data—VITAVA PROJECTION PAPER

**Purposes:** Vitava Projection is a fast paper for enlarging, with a little less warmth than Vitava Opal. It is well suited for making exhibition prints, especially of large heads and other subjects rendered more pleasing with a slight amount of warmth.

**Tone:** Slightly less warm than Vitava Opal, but warmer than Kodabromide. Slightly warmer tones result from overexposure, and slightly colder tones result from underexposure and consequent changes in development time. The range of over and underexposure is naturally limited.

### Contrast Grade, Speed, and Exposure Scale Values:

<i>Contrast Grade</i>	<i>Speed</i>	<i>Exposure Scale Value</i>	<i>Type of Negative Suited</i>
2	240	1:15	Normal Slightly Flat
3		1:10	

### Weights and Surfaces:

<i>Tint and Surface</i>	<i>Double Weight</i>
Cream White, Lustre, Fine Grained	G No. 2, 3
Cream White, Lustre, Silk	Y No. 2, 3
Old Ivory, Lustre, Fine Grained	P No. 2, 3

**Safelight Recommendations:** The Wratten Safelight Series OA is preferable for judging print depth during development, but the Wratten Series O can be used.

**Development Recommendations:** (at 68° F—20° C)

<i>Kodak Developer</i>	<i>Dilution</i>	<i>Recommended Time</i>	<i>Useful Range</i>
Selectol or D-52	1:1	120 sec.	90 to 240 sec.

**Acid Stop Bath:** Rinse at least 5 seconds in Kodak SB-1, with agitation.

**Fixing:** 5 to 10 minutes in fresh Kodak F-1, with agitation.

**Washing:** One hour in running water, with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes.

**Drying:** Glossy prints can be ferrotyped. All other prints should be put face down on clean glass and excess water removed with a roller, sponge, or squeegee; they can then be dried in the Kodak Photo Blotter Roll, between clean photographic blotters, or face down on clean cheesecloth stretchers or an old, well-laundered sheet.

**Recommended Toners:** Vitava Projection is especially suited for sepia toning in Kodak Hypo Alum Sepia Toner T-1a. Excellent results can also be secured with Kodak Gold Toner T-21. Kodak Selenium Toner produces pleasing brown tones and Kodak Blue Toner, cold blue tones.

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## Data—VITAVA OPAL PAPER

**Purpose:** Vitava Opal has ample speed for enlarging with faster equipment. It is ideal for projection prints and can be used for contact prints from paper negatives or from original negatives of normal contrast, by using reduced printing illumination. Vitava Opal's warmth and quality make it excellent for exhibition prints, especially of large heads and other subjects improved by warmth of tone.

**Tone:** Somewhat warmer than Vitava Projection. Warmth of image tone can be controlled within certain limits by varying the exposure and development time. It responds quite well to developer manipulation.

**Contrast Grade:** Vitava Opal is supplied in one contrast grade only, for negatives of average contrast. Exposure scale value is 1:14.

**Relative Speed:** 125.

### Weights and Surfaces:

<i>Tint and Surface</i>	<i>Double Weight</i>	<i>Tint and Surface</i>	<i>Double Weight</i>
Cream White, Lustre, Smooth	B	Cream White, Matte, Suede	V
Cream White, Matte, Smooth	C	Old Ivory, Lustre, Fine Grained	P
Cream White, Lustre, Fine Grained	G	Old Ivory, Matte, Fine Grained	Q
Cream White, Matte, Fine Grained	H	Old Ivory, Lustre, Rough	U
Cream White, Lustre, Rough	L	Old Ivory, Lustre, Tweed	S
Cream White, Matte, Rough	D	Old Ivory, Matte Suede	W
Cream White, Lustre, Tweed	R	Old Ivory, Lustre, Tapestry	Z

**Safelight Recommendations:** The Wratten Safelight Series OA is preferable for judging print depth during development, but the Wratten Series O can be used.

**Development Recommendations:** (at 68° F—20° C)

<i>Kodak Developer</i>	<i>Dilution</i>	<i>Recommended Time</i>	<i>Useful Range</i>
Selectol or D-52	1:1	120 sec.	90 to 240 sec.

**Acid Stop Bath:** Rinse at least 5 seconds in Kodak SB-1, with agitation.

**Fixing:** 5 to 10 minutes in fresh Kodak F-1, with agitation.

**Washing:** One hour in running water, with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes.

**Drying:** Glossy prints can be ferrotyped. All other prints should be put face down on clean glass and excess water removed with a roller, sponge, or squeegee; they can then be dried in the Kodak Photo Blotter Roll, between clean photographic blotters, or face down on clean cheesecloth stretchers or an old, well-laundered sheet.

**Recommended Toners:** Vitava Opal Papers tone well in Kodak Hypo Alum Sepia Toner T-1a. For toning in Kodak Gold Toner T-21, Opal Paper is probably the best suited of all the Kodak Photographic Papers. Kodak Blue Toner produces pleasing blue tones. Kodak Selenium Toner can also be used.

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## Data—ROYAL BROMIDE PAPER

**Purpose:** Royal Bromide is an enlarging paper of extreme speed, well suited to the requirements of many commercial photographers and photofinishers. Because of its speed, this paper is also popular with many amateur photographers whose enlargers are of low light intensity.

**Tone:** Blue-black.

### Contrast Grade, Speed, and Exposure Scale Values:

<i>Contrast Grade</i>	<i>Speed</i>	<i>Exposure Scale Value</i>	<i>Type of Negative Suited</i>
1	1,000	1:25	Contrasty
2		1:14	Average
3		1: 9	Flat
4		1: 6	Very Flat

**Weights and Surfaces:** F—Single Weight, white, smooth, glossy—Contrast grades Nos. 1, 2, 3, 4.

**Safelight Recommendations:** Wratten Series OA.

**Development Recommendations:** (at 68° F—20° C)

<i>Kodak Developer</i>	<i>Dilution</i>	<i>Recommended Time</i>	<i>Useful Range</i>
Dektol or D-72	1:2	60 sec.	45 to 120 sec.

**Acid Stop Bath:** Rinse at least 5 seconds in Kodak SB-1, with agitation.

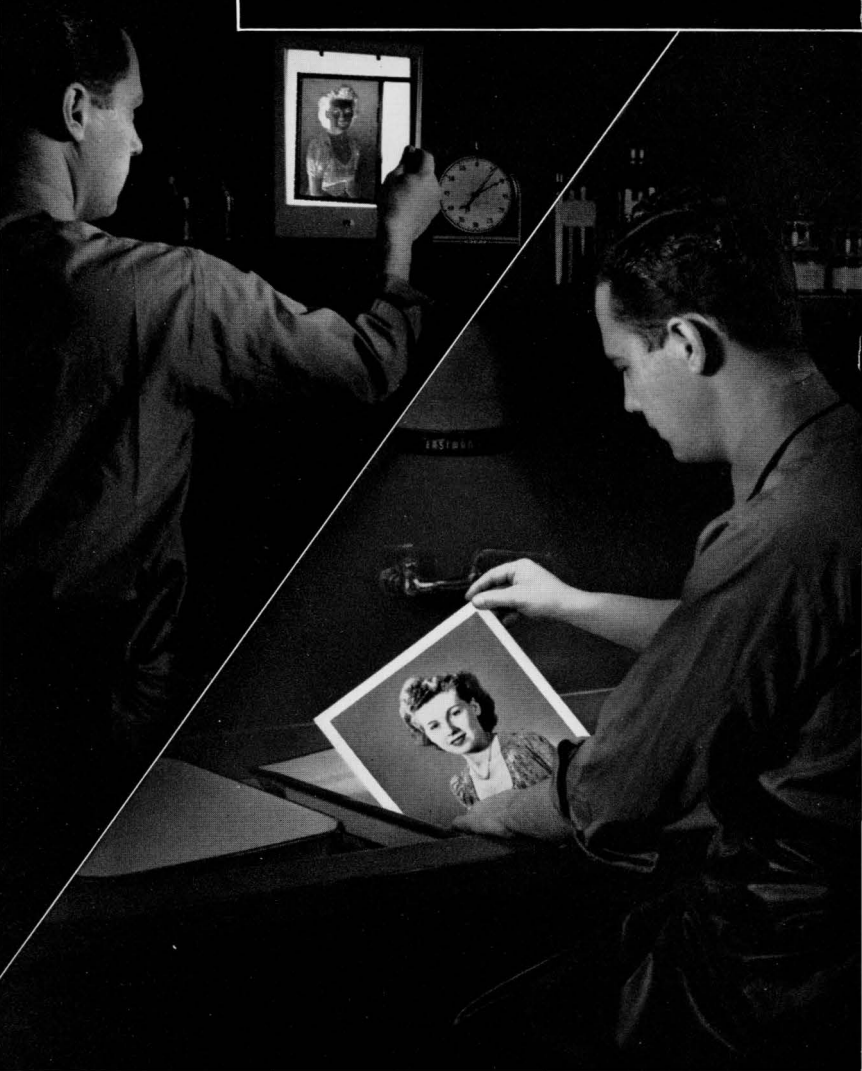
**Fixing:** 5 to 10 minutes in fresh Kodak F-1, with agitation.

**Washing:** One hour in running water, with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes.

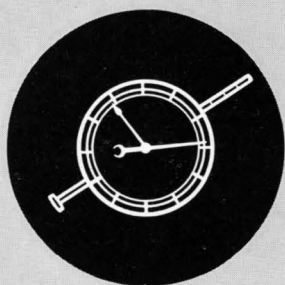
**Drying:** Glossy prints can be ferrotyped. All other prints should be put face down on clean glass and excess water removed with a roller, sponge, or squeegee; they can then be dried in the Kodak Photo Blotter Roll, between clean photographic blotters, or face down on clean cheesecloth stretchers or an old, well-laundered sheet.

**Recommended Toners:** Beautiful sepia prints may be obtained with Kodak Sepia Toner or Kodak Sulfide Sepia Toner T-7a.

# FORMULAS AND PROCESSING







# PROCESSING

## PROCESSING PRINCIPLES

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# PROCESSING

WHEN a film is exposed in a camera, there is no visible effect, but it is certain that there must be some invisible change, producing what is called a "latent image." In order to obtain a visible, usable image, the exposed film must be treated in a *developer* which can convert the invisible latent image into a visible image of metallic silver.

After development, the emulsion still contains the sensitive silver halides which were not utilized in producing the image, and these would darken on exposure to light and obscure the image. Therefore, in order to make the image permanent, the emulsion is "fixed" in a solution which removes the undeveloped silver halides, but does not affect the silver image. After fixing, the emulsion must be washed thoroughly to remove the chemicals used in developing and fixing.

## SAFELIGHTS

Since photographic materials are sensitive to light until after they have been fixed, the processing operations and all other handling must be carried out in total darkness, or by the illumination from a suitable safelight. Since the different classes of photographic materials have widely varying sensitivities, Wratten Safelight Filters are supplied in various colors and intensities, as follows: Series 00, clear yellow; Series O, bright orange; Series OA, greenish yellow; Series 1, orange red; Series 2, deep red; Series 3, dark green; Series 7, green (for use with infrared sensitive materials). The safelights recommended for use with the various Kodak materials are shown in the table of development recommendations.

With direct illumination, where the light from the bulb shines directly through the safelight to the working space a ten watt bulb should be used in the safelight lamp. With indirect illumination, where the light is reflected from a matte white surface either inside or outside the safelight lamp, a twenty-five watt bulb can be used for all except panchromatic negative materials, for which the bulb should not be stronger than 10 watts.

# PROCESSING PRINCIPLES

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## HOW THE DEVELOPER WORKS

A photographic material consists of a mechanical support, such as film, glass, or paper, on which is coated a light-sensitive emulsion consisting of minute crystals of silver halide (usually bromide or chloride) suspended in gelatin. Exposure to light alters these crystals in some way to produce the invisible latent image.

When the material is placed in a developer solution, the unexposed crystals are not affected, while the latent image activates the developer so that it acts on the exposed crystals, freeing the silver from its compound and depositing it as tiny irregular grains of metallic silver. The multitudes of these minute grains form the black silver image.

## COMPOSITION OF THE DEVELOPER SOLUTION

There are many different formulas for the developer solutions, but almost all practical formulas contain four essential constituents: developing agent, accelerator, preservative, and restrainer.

The developing agent reduces the silver from its compound to form the image. The most important agents, which are used singly or in combination, are Elon, hydroquinone, and pyro. An alkali, such as sodium carbonate, borax, Kodalk, or sodium or potassium hydroxide, is added as the accelerator to make the developing agent become sufficiently active. The preservative, sodium sulfite, is necessary to minimize the effect of aerial oxidation of the developing agent and tends to maintain the solution colorless during mixing and storing. Many formulas also require a small quantity of potassium bromide to restrain the developer from acting on the unexposed silver bromide crystals and thereby producing a general fog. In addition to these main constituents, developer solutions often contain small quantities of other substances, such as sodium bisulfite, sodium sulfate, alcohol, etc., added for special purposes.

## FACTORS AFFECTING DEGREE OF DEVELOPMENT

The density obtained in a developed image depends on the nature of the emulsion, the exposure that it has received, and the degree of development. With any particular emulsion, the degree of development depends on the time of development, the temperature of the developer, the degree of agitation of the material or developer solution, and the activity of the developer, which is determined by the composition and dilution of the solution and the degree of exhaustion.

## **Time of Development**

When the exposed film is placed in the developer, the solution penetrates the emulsion and begins to reduce the exposed crystals to metallic silver. The longer the development is carried on, the more silver is formed and the blacker the image becomes; the contrast, or difference between highlights and shadows, also increases.

The degree of development, or development contrast, is measured by the slope of the straight-line portion of the characteristic curve of the film. This value is known as "gamma."

If development is carried too far, the contrast may become too high, and the developer may begin to act on the unexposed silver bromide crystals; this causes "developer fog" which tends to veil the details in the shadows. Development should be stopped when the desired contrast has been reached. Since the contrast desired may vary somewhat in different cases, time-gamma curves are usually given in film specifications, so that the proper developing time can be selected for particular circumstances.

## **Temperature of Developer Solution**

The rate of development is affected by the temperature of the solution. As the temperature rises, the rate of development increases. Thus, when the developer temperature is low, the reaction is slow and the development time recommended for the normal temperature would give underdevelopment; when the temperature is high, the reaction is fast and the same time would give overdevelopment. Within certain limits, these changes in the rate of development can be compensated for by increasing or decreasing the development time.

Besides these changes in development rate, there are other important effects dependent on the temperature. At high temperatures, the gelatin of the emulsion becomes so swollen and tender that it is easily damaged, and it may even loosen from the support, or wrinkle up in a fine network of lines, called "reticulation." The temperatures of the developer and other solutions must be kept sufficiently low to avoid danger of damage. When it is necessary to work at high temperatures, the special precautions described under "High Temperature Development" should be taken to prevent injurious effects on the film.

## **Agitation of the Developer**

If a film is placed in a developer solution and allowed to develop without any movement, the action soon slows down, because the developing power of the solution in the emulsion and in contact with its surface becomes exhausted. If the film is agitated, however, fresh portions of

solution are continually being brought to the film surface, and the rate of development remains constant. Therefore, agitation has an important effect on the degree of development obtained. An even more important effect of agitation is prevention of uneven development or mottle. If there is no agitation, the exhausted solution, loaded with bromide from the emulsion, may flow slowly across the film from the dense highlight areas, and produce uneven streaks. Agitation keeps the solution uniform throughout and prevents this uneven development.

Since the degree of agitation affects the rate of development, the statement of a development time would mean little if the degree of agitation were not included. The developing times mentioned in various places in this book, and in other Eastman Kodak Company publications, usually relate to one or the other of two general types of agitation, tank or tray, as described under "Instructions for Practical Development."

### **Activity of the Developer Solution**

The rate of development is affected also by the chemical activity of the developing solution. This depends upon the composition of the formula, primarily upon the nature and concentration of the developing agent and the effective alkalinity of the solution. For example, Kodak Developer D-76 with its mild alkali, borax, has a slower rate of development than Kodak DK-60a containing Kodalk; this in turn is slower than Kodak D-11 which contains sodium carbonate. Also, the solution's activity is controlled by any dilution of the developer.

In addition, the exhaustion of the developer affects the activity of the solution. When a developer is used, its developing power decreases, partly because of the destruction of the developing agent in changing the exposed silver bromide to metallic silver, but primarily because of the restraining effect of the accumulated reaction products of the development. Even when the developer is not used, the activity may decrease slowly because of aerial oxidation of the developing agent.

### **REPLENISHERS**

The decrease in developer activity can be partially overcome by increasing the development time, but when large quantities of solution are involved it is better to compensate for this effect by periodically adding small quantities of a stronger "replenisher" solution. These replenishers are of such strength that when used to replace the developer carried out by the film (6 to 8 gallons per 1000 film rolls in deep tank or  $\frac{3}{4}$  to 1 ounce per 80 square inches) the developer activity is held approximately constant. It is not desirable, however, to attempt to prolong the life of the developer indefinitely.

## **STOP BATHS**

The primary purpose of an acid rinse or stop bath between development and fixation is to check development instantly by neutralizing the developer carried over. This also protects the acidity of the fixing bath from exhaustion. A hardening stop bath is desirable for films and plates in warm weather since it serves to harden the gelatin as well as to neutralize the developer. The use of a stop bath is recommended particularly for paper prints, which often tend to stain when transferred directly from developer to fixing bath without thorough agitation in the fixing bath.

## **ACTION OF THE FIXING BATH**

After development is completed, the undeveloped silver halide crystals remaining in the emulsion must be removed in order to prevent them from darkening and obscuring the image. Fixation is accomplished by treating the emulsion in a solution of sodium thiosulfate, or "hypo," which forms a soluble compound with the silver halide, but has practically no effect on the silver image under normal conditions of use.

In addition to the hypo, most practical fixing baths contain an acid, such as acetic acid, a preservative, sodium sulfite, and a hardening agent, such as potassium alum. The acid is added to neutralize the developer carried in the emulsion; thus it stops development and prevents the developer from causing trouble in the fixing bath. The sodium sulfite is necessary to prevent the hypo from being decomposed by the acid. The alum is added to harden the gelatin of the emulsion in order to prevent excessive swelling or softening in the wash water, particularly under summer conditions.

As the fixing bath is used, the developer carried in by the film gradually neutralizes the acid and finally produces a sludge of aluminum sulfite which renders the bath useless. If boric acid is added to a fixing bath of this type, the quantity of developer that can be added before the sludge appears is considerably increased, and thus the useful life of the bath is lengthened.

### **Time of Fixation**

In use, the fixing bath should not only dissolve the silver bromide grains, but also remove these dissolved silver salts from the emulsion. Therefore, after the last visible trace of silver bromide has disappeared, or after the milky portions of the emulsion have cleared, the film should be left in the bath for several more minutes to allow the silver salts to diffuse out of the emulsion. A good rule is to let the bath act for twice the time it takes to clear the emulsion. The bath must fix the whole

area of the emulsion, which it cannot do if several films or prints are piled together on top of one another. Therefore, they should be kept separated, and the bath should be agitated from time to time.

As the bath is used, the silver compounds accumulate in the solution; the bath becomes slower in action and has more difficulty in removing the last trace of silver salt from the emulsion. If the bath is kept in use too long, past the point when it takes twice as long to fix as it did when fresh, it may lose its ability to remove all of the unused silver salts. Although not visible, these will remain in the emulsion even after washing, and, with age, will decompose and stain the negative or print. In order to insure complete fixation, it is a good plan to use two baths, treating the sensitive material in the first until the emulsion has cleared, then transferring it to a second bath for an equal time. Thus, the first bath does most of the work, and the second bath removes the last traces of the silver compounds. This two-bath system is particularly desirable when print permanence is important.

### **Testing Stop Baths and Fixing Baths**

Stop baths and fixing baths should not be used beyond exhaustion, as this leads to stains and spots on the negatives or prints, which may be evident immediately, or after some time. An overworked stop bath ceases to check development by neutralizing the developer. Instead, the amount of developer carried over into the stop bath has become so great that it neutralizes the acid, making it useless as a stop bath.

As the appearance of both stop baths and fixing baths does not change until well beyond their useful lives, some means of determining quickly and accurately when they are unsafe for further use should be employed. The Kodak Testing Outfit for Stop Baths and Fixing Baths for films, plates, and papers provides a positive method of testing.

Testing solution "A," for testing the stop bath, changes from yellow to purple when the acidity of the bath becomes too low to stop development. Testing solution "B," for testing the fixing bath, is a colorless solution which immediately forms a heavy yellow precipitate when it is added to a sample of fixing solution exhausted due to the accumulation of silver salts dissolved from undeveloped parts of the emulsion.

### **NECESSITY FOR WASHING**

After all of the undeveloped silver bromide has been removed, the emulsion is still saturated with the chemicals of the fixing bath. If the hypo were allowed to remain, it would slowly decompose and attack the image, causing it to become discolored and faded. To prevent this, the hypo must be removed by washing.



## Time for Complete Washing

Only exact experimental measurements will tell how soon a particular vessel and stream of water will wash a specific kind of paper or film.

Complete washing is obtained in the minimum time when the emulsion is exposed to a rapid flow of fresh water, as when the stream from a faucet is allowed to flow over the emulsion surface. When the best conditions of agitation and water renewal are used, the following approximate times of washing will effect fairly satisfactory removal of hypo from films, plates, and paper prints:

Film Negatives and Plates	. . .	30 minutes
Single Weight Papers	. . .	60 minutes
Double Weight Papers	. . .	1 to 2 hours

Hypo is generally eliminated from most negative materials in 30 minutes if the rate of flow of water is rapid enough to replace the water completely in the washing vessel once every five minutes. Paper prints should be washed at least one to two hours under these conditions to insure satisfactory freedom from hypo. The time is measured from the immersion of the last plate, film, or print in the washing vessel, since the washed and partly washed emulsions absorb hypo from contaminated water just as readily as they give it up to fresh water.

## Print Permanence

Papers require a longer washing time than films, because small quantities of hypo are held tenaciously by the paper base and are difficult to wash out. As a result, even under good washing conditions traces of hypo may remain in the paper.

When permanence of the print image is important, or when it is difficult to obtain thorough washing, well-fixed prints should be treated in Hypo Eliminator HE-1. This eliminator, consisting of two volatile chemicals which do not remain in the paper, oxidizes the hypo to sodium sulfate, which is inert and readily soluble in water.

Although the use of Hypo Eliminator HE-1 completely removes the hypo, the silver image on the paper can still be affected by atmospheric conditions. To further increase the permanency of the image, the print should be immersed in Kodak Gold Protective Solution GP-1. This protects the image with a gold coating which is far less susceptible to attack by external forces. Additional protection from atmospheric forces is possible by insulating the print on both sides. This is done by mounting the print on a heavy card with Kodak Dry Mounting Tissue and then covering the face of the print with Kodak Print Lacquer.

# PROCESSING TECHNIQUE

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## PROCESSING OF FILMS

Tank development by the time-and-temperature method with intermittent agitation is highly recommended for roll films, film packs, sheet films, and plates. The use of a tank enables the operator to produce clean, evenly developed negatives, and also permits more accurate control of development factors than is possible in any other way. Tank development is the only practical method of handling 35-mm films.

With small tanks, the developer solution can be poured back into a bottle for storage, while larger tanks are usually left filled, preferably with a floating cover to protect the developer from aerial oxidation. Solutions used for tray development had best be discarded after one use.

### Developing Times

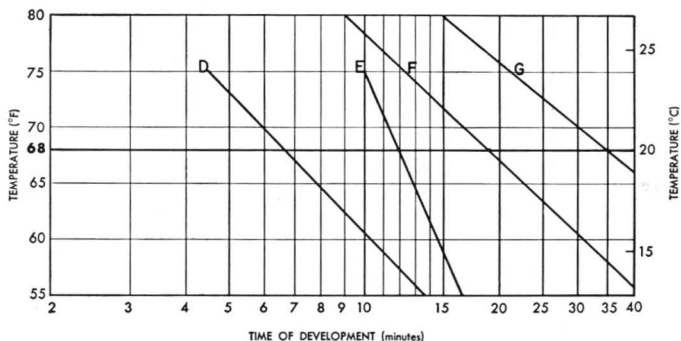
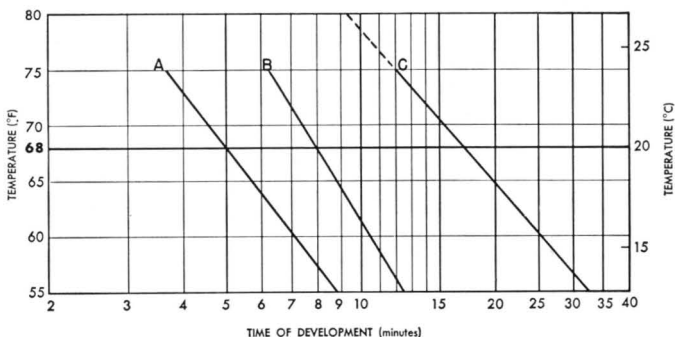
Development recommendations appear in the tables *Development—Kodak Sheet Films and Plates* and *Development—Kodak Films and Papers*. In each case the recommended times are chosen to give the most suitable contrast for the types of work for which the film is most generally used. Thus the development times recommended for portrait films give somewhat lower contrast than those for press films, and the recommended photofinishing development for roll films, which are generally printed by contact, gives slightly more contrast than the recommendations for films for miniature cameras, which are usually enlarged. The times can be modified if some other degree of development is preferred.

The development times given under each formula, and on the labels of packaged developers, are average times which give good results with most materials; naturally they cannot agree exactly with the different times given individually for each different material.

The recommended development times for films and plates are usually given for 68° F (20° C). Whenever it is necessary to work at some other temperature, compensation can be made within limits by increasing or decreasing the time of development. The time adjustment required for various temperatures to give approximately the same contrast as the recommended time at 68° F is indicated for certain developers in the Time-Temperature Development Charts on the following page. Thus, for high temperatures, shorter times are required and for low temperatures, longer times are necessary to produce the same contrast. Nevertheless, for best results, the temperature of the developer should be kept between 65° F and 70° F.

## Time-Temperature Development Charts

When the developing time required to produce the desired contrast at 68° F is known, these charts can show the proper time to produce approximately the same contrast at other temperatures. Through the point for the correct developing time at 68° F, draw a line parallel to the heavy line representing the developer. Then the required developing time will be found directly below the point where this new line cuts the line for the temperature to be used. The lines in these charts show the slope of the time-temperature relations. The positions of the lines do not necessarily indicate recommended development times.



**A—D-11**

D-61a (1:1) (1:3)

D-72 (1:1) (1:2)

Dektol (1:1)

**B—D-7 (1:1:1:8)**

D-11 (1:1)

D-19

DK-50

**C—DK-20**

D-76

Microdol

**D—DK-60a**

E—D-7 (1:1:1:13)

DK-50 (1:1)

**F—D-23**

G—D-25

## Instructions for Practical Development

In the development of films and plates, some methods of agitation must be followed which will permit uniform development and freedom from flow marks. The procedures described in the following pages are recommended to produce uniform, high-quality results. These instructions assume correct use of the recommended safelight.

### **Small Tank Development: Roll Films, Film Packs, and Small Sizes of Sheet Film (in Tanks with Removable Reels or Racks).**

Fill the tank with developer at the proper temperature, 68° F (20° C); turn out the light; load the film on the reel and proceed as follows:

1. Start the timer. Place the loaded reel in the tank containing the developer. Keeping the reel under the surface of the solution, tap it gently on the bottom of the tank to aid in dislodging air bells before replacing the cover. After the cover has been replaced on the tank, developing and other operations can be done in full room light.

2. After the reel has been immersed 30 seconds, agitate the tank for five seconds by sliding it back and forth briskly while at the same time turning or rotating it back and forth through about one-half turn. Repeat the agitation at intervals of 30 seconds.

*With the Kodak Day-Load Tank*, agitate the film by rotating the knurled collar of the tank in only a counterclockwise direction for one minute after the developer has been poured into the tank and for 5 seconds at two-minute intervals thereafter until development is complete.

3. At the completion of development pour out the developer and fill the tank with cold water or stop bath to rinse the film. With a water rinse, empty and fill the tank several times.

4. Pour the fixing bath into the tank and agitate the tank as above for about 30 seconds. Repeat this agitation several times during fixing.

5. When fixation is complete, wash the negatives for 30 minutes in running water. This can be done in the uncovered tank. Empty the tank at five-minute intervals to obtain thorough washing.

**Tank Development: Sheet Films and Plates in Hangers.** No more films should be developed than can be accommodated with at least one-half inch separation between the hangers. With the processing solutions at 68°F (20°C) load the developing hangers and proceed as follows.

1. Start the timer. Assemble the hangers and lower them as a unit smoothly and carefully into the developer and immediately tap the crossbars of the hangers two or three times on the upper edge of the tank to dislodge any airbells. Then separate the hangers to leave

approximately equal spacings of at least one-half inch between them.

2. Leave the hangers undisturbed for one minute. Then lift them clear of the solution, drain for one to two seconds from one corner, and replace smoothly in the solution. Repeat at one-minute intervals.

3. When development is complete, lift the hangers from the developer, drain, and transfer to the rinse water or stop bath. Lift and drain the hangers several times before transferring to the fixing bath.

4. Agitate the hangers vertically for about ten seconds and again at the end of the first minute, then allow to remain until fixing is complete, although frequent agitation will shorten fixing time.

5. Wash the negatives thoroughly in running water for at least 30 minutes, emptying the tank at five-minute intervals.

**Tray Development: Roll Films.** With the solutions at the proper temperature, follow these steps:

1. Unroll the paper backing and fasten a film clip to the end of the film. Place the clip over a hook on the wall (about 6 feet above the floor) and slowly unwind the remainder of the film, maintaining a slight tension to prevent coiling. Detach the film at its lower end from the protecting paper backing and attach a film clip.

2. Remove the clip from the hook and allow the film to sag in a U loop with the emulsion side down. Pass the film through water (68° F) by alternately lowering one end while raising the other at the rate of once every 5 seconds for about one minute. This helps to prevent the formation of air bells and greatly reduces the tendency to curl.

3. Start the timer. Turn the film so that the emulsion side is up and transfer promptly to the developer. Proceed in the manner described above, and continue the movement throughout development.

4. Pass the film up and down through the rinse water two or three times.

5. Transfer to the fixing bath contained in a deep tray and continue agitating for two minutes. Then place one end of the film in the fixing tray, emulsion side up, and lower the strip into the solution in folds. For shallow trays or long rolls it may be desirable to cut the negatives in two or three lengths to avoid looping in the tray. Move the films at intervals to insure uniform fixation.

6. When fixation is complete, place the films in a deep washing tray and wash thoroughly in running water for at least 30 minutes.

**Tray Development: Single Sheet Film or Plate.** Tray development of a single film or plate can be accomplished best by placing about ½ inch of developer in a tray which is appreciably larger than the film. With the solutions at the proper temperature, proceed as follows:

1. Start the timer and immediately slide the film, or plate, smoothly into the developer, emulsion side up. Agitate the tray continuously throughout development as follows:

Raise the left side of the tray about  $\frac{1}{2}$  to  $\frac{3}{4}$  inch above the bench top; lower smoothly, and then immediately raise and lower the near side similarly; continue agitating by raising and lowering the right side and then again the near side. These four operations constitute an "agitation cycle," which requires a total time of about 8 seconds.

2. When development is complete, rinse the film in a separate tray with agitation for about 5 seconds in fresh water or a stop bath.

3. Transfer the film to the fixing bath and agitate by rocking the tray as described above for about 30 seconds. Repeat the agitation at intervals for the duration of the fixing time.

4. Wash the negative thoroughly in running water for at least 30 minutes.

**Tray Development: Several Sheet Films.** The following method of developing two to six films in a tray is capable of producing good negative uniformity. Nevertheless it should be used with great care, especially when panchromatic film is handled in total darkness, to prevent digs or finger marks. Also, the temperature of the developer should not exceed 68° F and the use of a highly alkaline developer should be avoided to prevent softening of the gelatin.

Using a tray slightly larger than the films and with solutions at the proper temperature, follow these steps:

1. Immerse the exposed films one at a time and emulsion side up in a tray of water (not above 70° F). The topmost film must be completely covered with water before the next film is placed over it. When all the films are in the tray, draw one film carefully from the bottom and place it on top. Handle the film only by the extreme edges and take care to prevent a corner of the film from digging into the emulsion of the film on the top of the pile. Repeat this replacement from bottom to top until the films have been leafed through twice. This procedure will prevent films from sticking together and also dislodge any airbells which may have formed. The addition of Kodak Photo-Flo to the water helps to prevent the formation of air bells.

2. Start the timer and transfer the films quickly, one at a time, from the bottom of the pile into the developer tray. Continue the rotation of films from bottom to top throughout the period of development. At intervals, turn the films end for end, emulsion side up, as they are placed on the top of the pile.

3. When development is complete, transfer the films, one at a time,

to the Kodak Stop Bath SB-1, and leaf through the pile twice. Contamination of the developer with the stop bath can be avoided by using one hand for removing the films from the developer and the other hand for immersing them in the stop bath.

4. Place the films, one at a time, in the fixing bath and continue the replacement from bottom to top two or three times immediately and then at intervals until the negatives are completely fixed.

5. Wash the negatives in running water for at least 30 minutes by continuing the rotational method or by placing the negatives in developing hangers and using a washing tank.

**Tray Development: Several Plates.** If several plates are to be developed in a tray, the tray should be large enough to hold all the plates in separate positions. Enough developer should be provided to cover the plates at all times as the tray is rocked. Overlapping of the plates during development and fixation can be avoided by the use of rubber suction cups, attached to the bottom of the tray and placed in such positions as to keep the plates separate when the tray is rocked.

With the solutions at the proper temperature, follow these steps:

1. Start the timer. Then, handling each plate individually and by the edges, slide the plate (emulsion side up) under the developer and into its proper position in such a manner that the entire emulsion surface is wetted almost instantly. Note the position of the plates so that they can be removed in the same order as they are immersed. With a large wad of cotton which has been previously soaked in the developer, swab lightly over the entire surface of each plate in order to remove air bells or dirt particles which may adhere to the emulsion.

2. Agitate the tray continuously throughout development as follows: Raise the left side of the tray  $\frac{1}{2}$  to  $\frac{3}{4}$  inch above the bench top; lower smoothly and then immediately raise and lower the near side similarly; continue agitation by raising and lowering the right side, and then again the near side. These four operations constitute an "agitation cycle" requiring a total of about 8 seconds. Do not allow any of the plates to become partially uncovered by developer.

3. At the end of the development time, take the plates from the developer in the same order as they were immersed and rinse them quickly in the water rinse or stop bath, then place them in the fixing bath. Contamination of the developer with the fixing bath can be avoided by using one hand for removing the plates to the water rinse or stop bath and the other hand for immersing them in the fixing bath.

4. When fixation is complete, wash the negatives thoroughly in running water for at least 30 minutes.

## **Drying Films and Plates**

After washing, grit and scum should be swabbed from the emulsion with a tuft of cotton applied under water. When the film is hung up to dry, water droplets should be removed from both sides with a damp Kodak Photo Chamois or soft sponge. Water marks can also be prevented without wiping by treating the film in a solution of Kodak Photo-Flo after washing. This allows the water to drain off evenly without leaving droplets.

Drying should be done in a warm, dry room free from dust and excessive drafts, or in a cabinet supplied with warm, filtered air.

## **Practical Replenishment**

The use of a replenisher solution to replace the developer carried out by the films automatically compensates for the loss of strength with use of the developer, since the quantity of replenisher is proportional to the quantity of film developed. However, the quantity of developer solution taken out by the film will vary with the processing conditions. The strengths of the replenisher formulas are balanced to suit their greatest need in deep tank and machine photofinishing; for other conditions adjustments may be necessary. If, after replenishment, the developer seems to have lost strength, more replenisher should be added, even though it is necessary to discard some developer. If the developer has gained in strength from replenishment, less replenisher should be added and sufficient ordinary developer solution added to keep up the volume.

With some developers, replenishment works satisfactorily with comparatively small volumes, provided that a close watch is kept on the developer activity in terms of negative quality and that the quantity of replenisher added is adjusted to keep the activity constant. Because the quantity of developer lost with each sheet or roll of film may vary, particularly when the developer is used in a small tank and poured back into a bottle for storage, it is desirable to add a certain measured quantity of replenisher for each sheet or roll of film. The addition of one ounce of replenisher for each 80 square inches of film is suggested. This is equivalent to one 8 x 10- or four 4 x 5-inch sheet films, or one 620 roll film, or one 36-exposure roll of 35-mm film.

It is impractical, however, to exhaust and replenish a developer indefinitely because the solution accumulates a silver sludge as well as particles of dirt and gelatin which may adhere to the film surface. The developed films should be examined carefully and the developer discarded if it shows any indication of giving trouble such as stain or fog, or if the strength shows much tendency to vary.



## High Temperature Development

Whenever possible, the temperature of the processing solutions should be held at 65° to 70° F. When this is not practical, special precautions must be taken to avoid excessive swelling and softening of the emulsion.

Most developers, with the exception of highly alkaline solutions, can be used up to 75° F, provided the development times are properly shortened, and effective hardening rinse and fixing baths are used.

At higher temperatures, the use of Kodak Hi-Temp Hardener or the Kodak Prehardener SH-5 before development will harden the emulsion sufficiently to allow use of normal solutions and processing procedure, even at temperatures as high as 110° F. Full instructions for use, including adjustment of developing time for various temperatures, are given with the Prehardener formula in the Formulas Section.

The use of the Prehardener is the simplest and safest procedure for processing at high temperatures. When the Prehardener is not available, however, Kodak Developers DK-15 and DK-15a, and also certain regular developers with sodium sulfate added, can be used at temperatures up to 90 or 95°F. Addition of the quantities of sodium sulfate shown in the table below will give approximately normal developing times at the higher temperatures. When using any of these developers, it is necessary to observe the following precautions:

1. Developer, stop bath, fixing bath, and wash water must be at the same temperature to within approximately 5° F.

2. After development, the film should be treated in a freshly prepared hardening rinse bath, such as Kodak Tropical Hardener or Kodak SB-4. The film should be agitated for several seconds when first immersed in the stop bath, and then left for 3 minutes.

3. The film should be fixed for about 10 minutes in a good acid hardening fixing bath, such as Kodak F-5.

4. The film should be washed for 10 to 15 minutes in running water or in several changes of water. A longer washing time may cause trouble.

KODAK DEVELOPERS	RANGE OF TEMPERATURES	KODAK SODIUM SULFATE (DESICCATED)	
		PER QUART (32 oz.)	PER LITER
D-11      D-19 D-61a    D-76	75° TO 80° F	1 OUNCE    290 GRAINS	50 GRAMS
	80° TO 85° F	2½ OUNCES	75 GRAMS
	85° TO 90° F*	3 OUNCES    145 GRAINS	100 GRAMS
DK-50   DK-60a D-72 (1:1)	75° TO 80° F	3 OUNCES    145 GRAINS	100 GRAMS
	80° TO 85° F	4 OUNCES    75 GRAINS	125 GRAMS
	85° TO 90° F*	5 OUNCES	150 GRAMS

\*If necessary to develop at 90° to 95° F, decrease the time about one-third.

## Rapid Film Processing

In some situations, such as in newspaper work, it is occasionally necessary to develop a negative as quickly as possible. The processing time can be shortened considerably over normal processing times by the use of a fast working developer such as Kodak D-19, Kodak Dektol and Kodak D-72, which are now recommended for press material, and by taking certain short cuts in fixing and washing.

For rapid processing, fixation can be considered adequate as soon as the milky appearance has cleared from the emulsion. The use of a fresh fixing bath and thorough agitation of the film in the fixing bath decreases the clearing time considerably. Some saving in time can be effected by increasing the hypo concentration to 3 pounds per gallon and adding ammonium chloride (Kodak F-7). For most satisfactory results, however, Kodak Rapid Liquid Fixer (with Hardener) is recommended. This is supplied as a concentrated fixer solution, with the hardener solution in a separate bottle. When mixed in the proportion of 2 ounces of fixer solution to 6 ounces of water and  $\frac{1}{4}$  ounce of hardener, the fixing rate is three to five times faster than with usual fixing baths, such as Kodak F-5, and the useful fixing capacity is considerably greater. The processing is completed by washing the film a few minutes in a rapid stream of water and drying with blasts of warm air directed against both sides of the film.

To hasten the drying and prevent the formation of water marks on the film, all drops of surface water should be removed by wiping both sides of the film with a Kodak Photo Chamois or soft sponge. Rapid drying can also be obtained by (1) treating the film in a saturated solution of potassium carbonate, which removes the water from the emulsion and leaves the film dry enough for printing, or (2) soaking the film in alcohol for a minute or so before drying it. Methyl alcohol should not be used since it attacks the film base. Ethyl alcohol can be used successfully provided that (a) the film is not bathed in the alcohol for too long a period, (b) the alcohol is diluted with 10% of water, and (c) the film is finally dried with air in a temperature not greater than 70° to 80° F. Soaking the film in undiluted alcohol and drying with air which is too hot may cause the gelatin to become opalescent. If this should occur, the opalescence can usually be removed by soaking the film in water and drying slowly.

After the rush prints have been made,\* the negatives should be returned to the fixing bath for five or ten minutes and then washed thoroughly and dried in the usual manner to prevent fading or staining if the negatives should be kept for any length of time.

## PROCESSING OF PAPERS

Correct processing of papers is vital to print quality and is best secured by following the manufacturer's recommendations. Excellent prints are possible only when the printing exposure is such that the desired print density is obtained in approximately the recommended development time. A common cause of "muddy" prints is underdevelopment. There is a natural tendency to pull out a rapidly darkening print before development is completed, but the resultant image is poor in tone and often mottled from uneven development. Overdevelopment or long treatment in an overworked solution is likely to cause a yellow stain due to developer oxidation products.

The developing tray should be somewhat larger than the print. This allows proper agitation and convenience in handling the prints. The exposed print is slipped edgewise and face up into the developer solution, so that it is covered quickly and evenly. During development, the solution should be agitated by rocking the tray or by keeping the prints in motion. The prints should be kept completely immersed during development.

After development, the prints should be transferred to the stop and fixing baths quickly, without any intermediate examination. After the prints have been rinsed carefully in an acid stop bath, such as Kodak SB-1, they should be fixed for 5 to 10 minutes at 68°F (20°C) in a suitable acid hardening fixing bath. The prints should be agitated in the fixing bath to insure thorough access of the solution to all parts of the print surface.

In order to insure complete fixation, it is desirable to use two successive baths. However, prolonged fixing should be avoided, particularly with warm tone prints, because of the tendency to bleach the image and to increase the difficulty of thorough washing.

The appearance of the prints in the fixing tray may be slightly deceptive. Upon drying, prints become somewhat darker and lose contrast, especially on matte papers, and this should be considered in judging prints for correctness of printing exposure.

The prints must be washed for at least one hour, with a flow of water sufficient to change the water in the tray 10 to 12 times an hour, and the tray should not be overloaded so that the prints mat together and are not kept moving by the stream of water. The Kodak Automatic Tray Siphon is a convenient device for providing efficient circulation of water.

Prints wash more slowly in cold water and, when possible, the wash water temperature should be maintained between 65° and 75°F.

After thorough washing, the prints should be placed on a clean glass or board and the excess water swabbed off with cotton or a viscose sponge. Glossy paper should be dried on ferrotype tins or drums when high gloss is desired. Prints which do not require ferrotyping can be dried in the Kodak Photo Blotter Roll, between sheets of Kodak Blotting Paper, or on clean cheesecloth stretchers. Ordinary blotters are too soft and linty, and may contain impurities which will affect the prints.

If prints curl after drying, they can be flattened by dampening their backs with water and re-drying between blotters under heavy pressure for two or three hours. Kodak Print Flattening Solution can be used to minimize curling of the prints.

In the case of prints which are to be toned, correct exposure and development is particularly important, and overfixing must be avoided. Small variation in tone of the original silver image may be accentuated with wide variations in the color of the toned print.

## **FAULTS IN NEGATIVES**

Most of the faults encountered in negatives can be avoided by care and cleanliness in all operations, not only exposing and processing but also loading the camera, preparing the processing solutions, and drying the finished negatives. Faulty negatives are usually the penalty of carelessness, but occasionally even the most painstaking worker may run into trouble. When this occurs, the appearance of the negative will often give a clue as to the cause of the trouble so that it can be avoided in future work.

**Blurred images** are usually caused by movement of the camera or subject during the exposure or by improper focusing. A dirty lens produces a hazy image lacking contrast, especially in the bright areas. The nature of the blurring will usually indicate the cause.

**Contrast and Density** faults result from errors in exposure or development. A negative with low contrast between highlights and shadows and low density but with good shadow detail usually results from underdevelopment. Low density with lack of shadow detail indicates underexposure or possibly underdevelopment in a cold, weak, or exhausted developer. Excessive contrast between the highlight and shadow areas is caused by overdevelopment in a warm or strong developer. High density may be the result of overexposure, overdevelopment or fog.

*Fog*, or general veiling of the negative, usually more noticeable in

shadow areas or margins may be due to light or chemical action. If the margin is clear, it may be due to light leaks in the camera or film holder. If the margins are fogged, it may be *light fog* before or during development or *chemical fog* from forced development or impurities in the developer solution. Fog due to unsafe darkroom lighting, usually from using substitutes for proper safelight filters, is a very common defect encountered by amateur photographers.

**Irregular Density** may be due to a variety of causes, such as uneven development due to uneven immersion in the developer or lack of agitation, uneven stopping of development, uneven light fog, or chemicals or solutions touching the film before development. Dark wavy lines and dark streaks are usually caused by light leaks in the camera or film holder. Fine dark lines may be due to abrasion of the emulsion by grit or rough spots in the camera or even by the fingers. Cinch marks, usually shorter and more numerous than camera scratches, may be produced by twisting the roll to tighten the film. Drying marks are areas of varying density the shape of water drops left on the film surface during drying. Mechanical injuries, such as blisters, melting or frilling of the emulsion, or reticulation, the formation of a fine network of lines or a grainy leatherlike appearance, are almost always the result of using the processing solutions at temperatures which are too high. Digs or scratches, caused by fingernails or the corner of another film and occurring at any temperature, are the result of careless handling of the film in the processing solution.

**Pinholes and Clear Spots** can be caused by dust or lint particles on the film surface at the moment of exposure, which usually make very small spots with sharp edges. They also can be caused by airbells or scum on the surface of the emulsion during development. Large spots may be caused by the shadow of some object close to the lens, such as the finger.

**Stains and Deposits** of various kinds can be caused by incorrect mixing of the processing solutions or by faulty processing technique. Inadequate fixing and washing are probably the commonest causes of stains. Descriptions of the various types of stains and instructions for corrective treatments can be obtained by writing to the Sales Service Division, Eastman Kodak Company, Rochester 4, New York.

If any negative or print shows a defect which cannot be diagnosed from its appearance, it may be sent to the Eastman Kodak Company for inspection. There is no obligation. As complete data as possible should be given as to the processing and other treatment received by the negative or print.

## **CLEANING PROCESSING APPARATUS**

Trays, tanks, and other processing equipment sometimes become discolored or coated with decomposition products of the photographic solutions. While this may do no harm if a container is always used for the same kind of solution, it is much better to clean all containers each time they are emptied. The simplest method of cleaning a tray or tank is to wash it out several times with water and then wipe the surfaces with a clean cloth. This procedure is preferable to the constant use of strong cleaning solutions which should be used only when washing is ineffective. Most cleaning solutions are either strong alkalis or acids and should be used with the same discretion given these chemicals when mixing photographic solutions.

### **Trays and Tanks**

Stains from oxidized developer are usually of brown or yellow brown color. Fresh stains can often be removed by washing with soap and water and wiping with a cloth. Severe stains require the use of a strong oxidizing solution such as Kodak Tray Cleaner TC-1 or TC-3. These cleaners will also remove most stains caused by deposits of silver or silver sulfide.

Developer tanks often become coated with a scale consisting essentially of basic calcium sulfite which is difficult to remove by scrubbing. This scale is soluble in acids, but the ease of removal varies according to the conditions under which the scale was formed. As a first trial the tank should be filled with Kodak Stop Bath SB-1 and allowed to stand overnight. If this does not loosen the scale sufficiently, a five per cent solution of acetic acid should be tried or, as a last resort, a two to five per cent solution of hydrochloric acid. The latter should be used with care particularly with stainless steel, on which it is apt to cause serious pitting. The tendency for formation of such scale can be greatly reduced by the use of Kodak Anti-Cal in the developer solution.

Large developer tanks of wood or stoneware often become coated with a layer of slime consisting of gelatin, organic matter, fungus and mold growths, and dust. Some of the molds or fungi can act on the sulfite of the developer and convert it to sodium sulfide, which is a strong fogging agent. Trouble from this source can be avoided by sterilizing the tank at regular intervals, especially during warm weather. The tank should be scrubbed thoroughly with a wire brush then filled with a solution of sodium hypochlorite and allowed to stand overnight. It should then be emptied and given another thorough scrubbing and five or six washings before being used again. Bleach solutions sold for

laundry use usually consist of sodium hypochlorite or a solution can be prepared by adding sodium carbonate solution to a solution of calcium hypochlorite (bleaching powder) until no more precipitate is formed.

### **Film Hangers and Clips**

Metal film hangers and clips tend to accumulate a plating of silver when immersed in a fixing bath which contains dissolved silver salts. Such deposits are often of a spongy nature and may be mixed with gelatin and other substances. These deposits absorb chemicals from the processing solutions which are not removed by ordinary washing and when the hangers are reimmersed in the developer, some of these chemicals may leach out and cause fog on the film.

There are four methods of removing such deposits, and the choice of method will depend on the severity of the conditions. The acetic acid treatment is the simplest; boiling with tri-sodium phosphate, however, will be more effective in the majority of cases. Tray cleaner should be used with caution on metal equipment.

**Acetic Acid Treatment:** Soak the hangers or clips for an hour in a tray or tank filled with 10 per cent acetic acid solution (1 part glacial acetic acid to 9 parts of water or 1 part 28% acetic acid to 2 parts of water). The acid tends to loosen the deposit. Then wash with clear water and scrub the deposit with a stiff brush. Most deposits can be loosened and removed by this treatment.

**Tri-Sodium Phosphate Treatment:** Boil the equipment for several minutes in a 10 per cent solution of tri-sodium phosphate then wash it with water and scrub thoroughly with a stiff brush. This method is especially useful for cleaning deposits of spongy silver mixed with gelatin. This method should not be used for aluminum ware.

**Acid Bichromate Treatment:** If the silver deposit clings tenaciously to the metal hangers, it may be necessary to dissolve it with Kodak Tray Cleaner TC-1 diluted 1 part TC-1 to 2 parts water.

The length of time the hangers or clips should remain in this solution depends on the quantity of silver to be removed. An immersion of 10 minutes is usually sufficient. When the articles are removed, rinse thoroughly and brush off any reddish colored scale. It is advisable to use a glass or hard rubber tray since an enamelled tray will be etched slowly by the cleaning solution. This solution should not be used with chromium plated metal articles because it tends to destroy the copper undercoating.

**Sandblasting:** Heavy deposits are best removed by sandblasting.

DEVELOPMENT—KODAK SHEET FILMS AND PLATES		
Kodak Sheet Films	Recommended Kodak Developers and Developing Times at 68°F (20°C)—Tank*	Safelight Wratten Series
NON-COLOR-SENSITIZED Commercial Commercial Matte }	DK-50, 6 min; DK-60a, 5 min	1
ORTHOCHROMATIC Commercial Ortho Ortho-X	DK-50, 9 min; DK-60a, 6 min DK-60a, 5 min; Maximum contrast: DK-60a, 10 min	2 2
Super Ortho-Press	Press: DK-60a, 6 min; D-19, 5 min; Dektol (1:1) or D-72 (1:1), 4 min	2
Super Speed Ortho Portrait Contrast Process Ortho	Commercial: DK-60a, 5 min; DK-50, 6 min DK-50 (1:1), 10 min; DK-60a (1:1), 8 min D-8 (2:1), 2 min (tray); D-11, 5 min	2 1
PANCHROMATIC Panatomic-X Super-XX Panchromatic Portrait Panchromatic Contrast Process Panchromatic Tri-X Panchromatic	D-76, 16 min; DK-60a, 5 min; DK-50, 6 min; Microdol, 16 min; DK-20, 18 min D-76, 20 min; DK-60a, 7 min; DK-50, 10 min D-7 (1:1:13), 7 min; DK-50 (1:1), 8 min; D-76, 17 min; D-61a (1:3), 6 min D-8 (2:1), 2 min (tray); D-11, 5 min DK-60a, 6 min; Maximum contrast: DK-60a, 12 min	3†
Super Panchro-Press, Type B	Press: DK-60a, 6 min; D-19, 5 min; Dektol (1:1) or D-72 (1:1), 4 min Commercial: DK-50, 7 min; DK-60a, 5 min Portrait: DK-50 (1:1), 8 min	
Super Panchro-Press, Sports Type	DK-60a, 8 min; D-19, 7 min; Dektol (1:1) or D-72 (1:1), 5½ min	
INFRARED-SENSITIVE Infrared	D-76, 8 min; Microdol, 9 min; DK-20, 9 min; Medical Use: DK-50, 11 min; Extreme contrast: D-19, 9 min	7
SPECIAL PRINTING FILM Translite	Selectol (1:1) or D-52 (1:1), 2 min	OA
<b>Kodak Photographic Plates</b>		
NON-COLOR-SENSITIZED 40 33 33 Matte } Process	DK-50 (1:1), 10 min; D-61a (1:3), 12 min; D-7 (1:1:13), 8 min D-8 (2:1), 2 min, (tray); D-11, 5 min	1
Lantern Slides, Medium	Versatol (1:3), Dektol (1:2) or D-72 (1:2), 1-3 min (tray) Warm Tones: D-32, 5 min (tray) Soft results: DK-50, 2-3 min (tray)	1
Contrast Contrast Anti-Abrasion }	Versatol (1:3), Dektol (1:2) or D-72 (1:2), 2-6 min (tray) High contrast: D-11, 5 min (tray)	1
ORTHOCHROMATIC Super Ortho Press	Press: DK-60a, 5 min; Dektol (1:1) or D-72 (1:1), 3½ min; D-19, 4 min Commercial: DK-60a, 4 min; DK-50, 6 min	
50 Polychrome } Commercial	DK-50 (1:1), 10 min; D-61a (1:3), 12 min; D-7 (1:1:13), 8 min	2
Metallographic	Low contrast: D-41, 4½ min; Medium contrast: D-41, 7 min; High contrast: D-42, 5½ min; DK-50, 8 min; Very high contrast: D-19, 10 min	
PANCHROMATIC Panatomic-X Panchromatic Process Panchromatic	DK-50, 5 min; D-76, 14 min; DK-60a, 4 min Normal contrast: D-76, 9 min; High contrast: D-11 (1:1) 4 min D-11, 5 min High contrast: D-8 (2:1), 2 min (tray)	3†
"M"	Low to normal contrast: D-41, 5 min; Medium contrast: D-41, 7 min; High contrast: D-42, 5½ min; DK-50, 6½ min; Very high contrast: D-19, 5 min	
Super Panchro-Press	Press: DK-60a, 5 min; Dektol (1:1) or D-72 (1:1), 3½ min; D-19, 4 min Commercial: DK-60a, 4 min; DK-50, 6 min	3
Tri-X Pan, Type B Tri-X Pan, Type B, Matte }	General photography: DK-50, 5 min Color separation: DK-50 and SD-17 (See directions with material.)	
INFRARED-SENSITIVE Infrared-Sensitive	D-19 (1:4), 4 min; D-11 (1:1), 5 min	7

\*Agitation at one-minute intervals. Tray development with constant agitation requires about 20% less time than tank development, except for those developers for which the tray dilution is different from the tank dilution as specified with each formula. †After development is half completed.



# DEVELOPMENT—KODAK FILMS AND PAPERS

Kodak Films	Recommended Kodak Developers and Developing Times at 68°F (20°C)—Tank*	Safelight Wratten Series		
ROLL FILMS AND PACKS				
Verichrome	Microdol, 16 min; D-76, 17 min; DK-20, 15 min; DK-60a, 7 min	2		
Plus-X	Microdol, 16 min; D-76, 17 min; DK-20, 15 min; DK-60a, 7 min	3†		
Super-XX	Microdol, 16 min; D-76, 17 min; DK-20, 15 min; DK-60a, 7 min	3†		
Super Ortho-Press Film Pack	(D-19, 8 min; D-72 (1:1), 4 min; DK-50, 8 min; DK-60a, 6 min	2		
Infrared	Microdol, 10 min; D-76, 9 min; DK-20, 10 min	7		
35MM AND BANTAM				
Panatomic-X	Microdol, 15 min; D-76, 14 min; DK-20, 14 min	3†		
Plus-X	Microdol, 16 min; D-76, 16 min; DK-20, 16 min	3†		
Super-XX	Microdol, 20 min; D-76, 20 min; DK-20, 23 min	3†		
Infrared	Microdol, 10 min; D-76, 9 min; DK-20, 10 min	7		
Kodak Direct Positive Panchromatic	See Instruction Sheet in Chemical Package Outfit Formulas and procedure also available on request.	T.D.**		
KODAK 35MM FILMS <i>For Special Purposes</i>				
Positive Safety	(For positives from: Flat negatives: D-11, 7 min Normal negatives: D-11, 3 min Contrasty negatives: D-11, 1½ min	0A		
High Contrast Positive Safety Micro-File	For positives from Line Negatives: D-11, 4 min D-11, 5 min	0A 3†		
Kodak Papers	Recommended Developer and Dilution	Time in Seconds at 68°F (20°C)	Time Range Seconds	Safelight Wratten Series
CONTACT PAPERS				
Azo	(Dektol or D-72 (1:2)	60	45 to 120	
Prof. Azo	(Selectol or D-52 (1:1) Warmer Tones	120	90 to 240	0A, 00
Ad-Type	Selectol or D-52 (1:1)	120	90 to 240	0A, 00
Velox	Dektol or D-72 (1:2)	60	45 to 120	0A, 00
Resisto	Dektol or D-72 (1:2)	60	45 to 120	0A, 0
Velox Rapid				
CONTACT OR PROJECTION PAPERS				
Vitava Opal Illustrators' Special	Selectol or D-52 (1:1)	120	90 to 240	0A, 0
PROJECTION PAPERS				
Vitava Projection Portrait Proof	Selectol or D-52 (1:1)	120	90 to 240	0A, 0
Kodabromide	(Dektol or D-72 (1:2)	60	45 to 120	0A, 0
Resisto Rapid	(Selectol or D-52 (1:1) Warm Tones	120	90 to 240	0A, 0
Royal Bromide	Dektol or D-72 (1:2)	60	45 to 120	0A, 0
SPECIAL PAPERS				
Linagraph Ortho	(Dektol or D-72 (1:2)	90		2
Linagraph Blue Sensitive	(Dektol or D-72 (1:1)	60		1
Super Speed Direct Positive	See Instruction Sheet in Package			
Reflex Copy	(Dektol or D-72 (1:2)	45		0A
	(Dektol or D-72 (1:1)	30		
*Tray development requires about 20% less time than tank development except for those developers for which the tray dilution is different from the tank dilution as specified with each formula.				
**Total darkness until the bleaching has been completed. A Wratten Safelight Series 0A can be used during clearing, redevelopment, and fixation.				
†After development is half completed.				

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Classification of Kodak Developers

<i>Material and Use</i>	<i>Recommended Developers</i>
Professional Films and Plates.....	DK-50, DK-60a, D-7, D-61a, D-76, D-23
Roll Films and Film Packs.....	DK-60a, D-76, DK-20
Films for Miniature Cameras.....	D-76, DK-20, D-25
Press Materials.....	D-72, D-19, DK-60a, DK-50
Fine Grain Development.....	DK-20, D-25
High Contrast Development.....	D-8, D-11
Tropical Development.....	DK-15, DK-15a
Kodalith Films, Plates, and Papers.....	D-85, D-8
Positive Films.....	D-72, D-11
Lantern Slide Plates.....	D-72, D-11, D-32
Translite Film.....	D-52
Printing and Enlarging Papers.....	D-72, D-52
Super-Speed Direct Positive Paper.....	D-88



FORMULAS

Mixing Solutions

Capacity and Life of Solutions

Prepared Chemicals

D-7 · D-8

D-11 · DK-15  
DK-15a · D-19  
D-19R

DK-20 · DK-20R  
D-23 · D-25 · DK-25R

D-32 · DK-50  
DK-50R  
D-52 · DK-60a  
DK-60aTR  
DK-60aMR

D-61a · D-61R  
D-72  
D-76 · D-76R

D-82 · D-85  
D-88 · R-9 · CB-1  
T-19

DK-93

Stop Baths  
Hardening Baths

Fixing Baths

Washing Test  
•  
Hypo Eliminator

Intensifiers

Reducers

Tray Cleaners  
•  
Stain Removers

Toners

DEVELOPERS

# CHEMICALS AND FORMULAS

PHOTOGRAPHY is essentially a chemical process involving many complex reactions of chemicals in solution. These reactions determine, to a high degree, the properties and quality of the processed images. Therefore, the purity, strength, and uniformity of the chemicals, the quantity of each used, and the manner in which they are combined, are of utmost importance in achieving results of uniformly high quality.

Because of these facts, and to meet the ever increasing demand for formulas and chemicals from which uniform results of high quality could be expected, Kodak formulas were evolved and Kodak Tested Chemicals were introduced. In order to assure accurately balanced solutions, and to save time for the darkroom worker, the Eastman Kodak Company makes available many of the more popular formulas in the form of packaged chemical preparations, which need only to be dissolved according to the directions on the package to be ready for use.

Kodak formulas and Kodak prepared chemicals are the result of years of painstaking, exhaustive research and wide practical experience. They are recommended with the confidence that they will assure the finest results possible with the materials for which they are intended.

For convenient and easy reference the formulas given here are grouped according to type, such as developers, fixing baths, toners, etc., and the formulas of each type are listed in numerical order.

## MIXING DEVELOPER AND FIXING SOLUTIONS

When developer solutions are made up, it is essential that the constituents be dissolved in the proper order if undesirable reactions are to be avoided. For instance, if the developing agent is dissolved first, and then the alkali is added, considerable aerial oxidation and formation of colored oxidation products will occur before the preservative, sodium sulfite, is dissolved. Therefore, the instructions given with the formula should be followed carefully. Usually the preservative is dissolved first, then the developing agents, then, after these are completely dissolved, the alkali. In the case of formulas containing the developing agent Elon, however, the Elon should be dissolved first, since it is readily soluble in warm water but only slightly soluble in sulfite solutions without alkali. After the Elon is completely dissolved the sulfite should be added, followed by the other developing agents, and finally the alkali. Since the potassium bromide has no action on the developing agents, it is immaterial at what stage it is added. When sodium bisulfite appears in the formula, it should be added with the sulfite.

When an acid hardening fixing bath is made up, it is essential that the ingredients be dissolved in the proper order if decomposition of the hypo and precipitation of the alum are to be avoided. The hypo should be dissolved first, then the sulfite, then the acid, and finally the alum. When the hardener stock solution is made up separately, the hardener should be added to the hypo solution slowly, with vigorous stirring. The preparation of baths containing chrome alum as the hardening agent is even more critical, and the directions should be followed carefully, particularly in regard to the stirring and temperature of the solutions.

In order to avoid the possibility of error in mixing, most Kodak formulas are arranged so that the ingredients are named in the order in which they should be dissolved. Therefore, the chemicals should be dissolved in the order given unless the directions specifically state otherwise.

Filtering is unnecessary if clear water and clean chemicals are used. However, if there is any sediment or suspension, the solution should be filtered before storage or use, preferably with Kodak Filter Cotton or filter paper held in a glass or enamel funnel.

Kodak Sodium Sulfite, desiccated, is specified in Kodak formulas. In those formulas containing sodium carbonate, the quantities given are for Kodak Sodium Carbonate, desiccated. If Kodak Sodium Carbonate, monohydrated, is used, the quantities given in the formula must be multiplied by seven-sixths.

## WEIGHTS AND MEASURES—CONVERSION TABLES

In American photographic practice, solids are weighed by either the Avoirdupois or the Metric system and liquids are measured correspondingly by U. S. Liquid or Metric measure. The following tables give all the equivalent values required for converting photographic formulas from one system to the other:

### Avoirdupois to Metric Weight

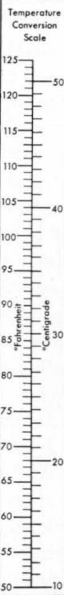
Pounds	Ounces	Grains	Grams	Kilograms
<b>1</b>	<b>16</b>	<b>7000</b>	<b>453.6</b>	<b>0.4536</b>
0.0625	<b>1</b>	437.5	28.35	0.02835
		<b>1</b>	0.0648	
	0.03527	15.43	<b>1</b>	0.001
2.205	35.27	15432	1000	<b>1</b>

### U. S. Liquid to Metric Measure

Gallons	Quarts	Ounces (Fluid)	Drams (Fluid)	Cubic Centimeters	Liters
<b>1</b>	<b>4</b>	<b>128</b>	<b>1024</b>	<b>3785</b>	<b>3.785</b>
0.25	<b>1</b>	32	256	946.3	0.9463
		<b>1</b>	8	29.57	0.02957
		0.125	<b>1</b> (60 mins.)	3.697	0.003697
		0.03381	0.2705	<b>1</b>	0.001
0.2642	1.057	33.81	270.5	1000	<b>1</b>

### Conversion Factors

Grains per 32 fluid oz.	multiplied by 0.06847	=grams per liter
Ounces per 32 fluid oz.	multiplied by 29.96	=grams per liter
Pounds per 32 fluid oz.	multiplied by 479.3	=grams per liter
Grams per liter	multiplied by 14.60	=grams per 32 fluid oz.
Grams per liter	multiplied by 0.03338	=ounces per 32 fluid oz.
Grams per liter	multiplied by 0.002086	=pounds per 32 fluid oz.
Ounces (fluid) per 32 oz.	multiplied by 31.25	=cubic centimeters per liter.
Cubic centimeters per liter	multiplied by 0.032	=ounces (fluid) per 32 oz.
cm. $\times$ .3937		=inches
		inches $\times$ 2.5400 =cm.



## Measurement of Small Quantities

When quantities of chemicals under 10 grains or 0.7 gram are included in a formula, they are expressed preferably as a 10 per cent solution to be added as so many drams or cc. If less than a dram is required, an even quarter fraction thereof should be used. This plan avoids expressing the volume in "drops," which is a very uncertain quantity varying as much as 150 per cent depending on the way it is measured and the specific gravity of the liquid used. The average drop from the usual dropping bottle or burette measures about one minim or approximately one-twentieth of a cubic centimeter.

To obtain a 10 per cent solution of a solid, dissolve one ounce of the solid in about 8 ounces of water, and add water necessary to bring the total volume to ten fluid ounces, or dissolve 10 grams of the solid to make 100 cc. of the solution.

## STORAGE OF SOLUTIONS

The mixed solution should be stored in a tightly corked bottle. Batches of stock solution are best stored in small bottles. The entire contents of a small bottle can be used at one time, leaving the remaining bottles undisturbed. When stock is used from a large bottle, the air space is increased each time the bottle is opened, and the chances for aerial oxidation are greatly increased. However, a small air space should be left to avoid loosening the stopper or bursting the bottle, as the solution volume varies with temperature changes. Glass stoppered bottles are not desirable, as the alkali is apt to make the stopper stick.

Developers which are particularly susceptible to aerial oxidation often are divided into two or three solutions in which the developing agent is kept separate from the alkali, thus reducing oxidation.

The solubilities of most chemicals decrease as the temperature is lowered. As a result, when the more concentrated solutions of developers and fixing baths are stored at low temperatures, there is a tendency for some of the ingredients to crystallize out of the solution. The precipitate which separates under such conditions often contains the most important constituents of the solution, such as the developing agents. Therefore, the precipitate should not be discarded, but should be redissolved by warming before the solution is used.

All deep tank developers, which are kept in use for a considerable time, should be protected when not in use with a thin sheet of Kodaloid in the form of a shallow boat which can be floated on the solution to prevent aerial oxidation. After removing the lid, the surface of the developer should be skimmed with a clean blotter to remove any scum each time before the developer is used.

When some acid hardener stock solutions are stored for several weeks, they tend to form a white incrustation of basic aluminum acetate on the inside of the container. This should be ignored as the incrustation usually does not impair the useful properties of the solution.

### The Question of "Parts"

It is often recommended to dilute a stock solution, say, one to two, or one part stock solution and two parts water. Parts should be taken to mean units of volume, any unit whatever being taken provided that the other quantities are reckoned in the same units of volume. Thus:

For Use, take		For Use, take
Stock Solution . . . . . 1 part	} may mean {	Stock Solution . . . . . 4 oz.
Water . . . . . 4 parts		Water . . . . . 16 oz.

## KEEPING PROPERTIES AND USEFUL LIFE OF SOLUTIONS

The figures given in this table are estimates based on experience and are intended for use only as a guide. The values for keeping properties without use are for 65° to 70°F. (18° to 21°C.) and are proportionately less at higher temperatures. The useful capacity figures are based on exhaustion of the solution without replenishment. Under most conditions longer life and greater capacity can be assumed if some change in quality is tolerable.

FORMULA	KEEPING-PROPERTIES WITHOUT USE				USEFUL LIFE 8 x 10-INCH SHEETS PER GAL.	
	TRAY	GALLON TANK	STOPPERED BOTTLE FULL	HALF FULL	TRAY	NARROW AND DEEP TANK
<b>Developers</b>						
Kodak D-7	8 Hrs.	1 Week	3 Mo. S.S. (3 Sol.)	2 Mo. S.S. (3 Sol.)	10	20
Kodak D-8	4 Hrs.	N.R.	2 Mo.	1 Mo.	15	30
Kodak D-11	24 Hrs.	1 Mo.	6 Mo.	1 Mo.	20	40
Kodak DK-15	8 Hrs.	1 Week	3 Mo.	1 Mo.	15	30
Kodak D-19	24 Hrs.	1 Mo.	6 Mo.	2 Mo.	30	60*
Kodak DK-20	24 Hrs.	1 Mo.	6 Mo.	2 Mo.	20	30*
Kodak D-32	2 Hrs.	N.R.	2 Mo. S.S. (2 Sol.)	2 Wks. S.S. (2 Sol.)	15	N.R.
Kodak DK-50	24 Hrs.	1 Mo.	6 Mo.	2 Mo.	20	40*
Kodak D-52	24 Hrs.	2 Wks.	3 Mo.	1 Mo.	80 (1:1)	N.R. Prints
Kodak DK-60a	24 Hrs.	1½ Mo.	6 Mo.	2 Mo.	20	40*
Kodak D-61a	24 Hrs. (1:1)	2 Wks. (1:3)	2 Mo.	3 Wks.	15 (1:1)	30 (1:3)
Kodak D-72	24 Hrs.	2 Wks.	3 Mo.	1 Mo.	20 (1:1) 15 (1:2) 120 (1:1) 100 (1:2)	40 (1:1) Neg. 30 (1:2) Neg. N.R. Prints N.R. Prints
Kodak D-76	24 Hrs.	1 Mo.	6 Mo.	2 Mo.	20	30*
Kodak D-82	2 Hrs.	24 Hrs.	1 Week	2 Days	10	20
Kodak D-85	4 Hrs.	N.R.	1 Mo.	3 Days	25	40
Kodak D-88	4 Hrs.	1 Day	1 Mo.	1 Week	40	50
Kodak DK-93	24 Hrs.	1 Mo.	6 Mo.	2 Mo.	20	40
<b>Stop Baths</b>			<b>65° F.</b>	<b>75° F.</b>		
Kodak SB-1 (Papers Only)	3 Days	1 Mo.	Indef.	Indef.	75	75
Kodak SB-1a	3 Days	1 Mo.	Indef.	Indef.	40	40 (With D-8)
Kodak SB-3	1 Day	1 Mo.	Indef.	Indef.	25	25
Kodak SB-4	1 Day	1 Mo.	Indef.	Indef.	25	25
Kodak SB-5	3 Days	1 Mo.	Indef.	Indef.	100	100
<b>Fixing Baths</b>						
Kodak F-1 (Papers Only)	1 Week	1 Mo.	3 Mo.	1 Week	( 50- W.R. - 50)** (100- SB-1 - 100)	
Kodak F-5	1 Week	1 Mo.	3 Mo.	2 Wks.	(100- W.R. - 100)** (100- SB-3 - 100)	
Kodak F-6	1 Week	2 Mo.	3 Mo.	3 Wks.	( 50- W.R. - 50)** (100- SB-1 - 100)	
Kodak F-10	1 Week	2 Mo.	3 Mo.	3 Wks.	(100- W.R. - 100)** (100- SB-3 - 100)	
Kodak F-16	3 Days	1 Week	1 Week	1-2 Days	( 50- W.R. - 50)** ( 75- SB-3 - 75)	
Kodak F-24	1 Week	1 Week	3 Mo.	2 Wks.	( 50- W.R. - 50)** ( 75- SB-3 - 75)	

\*Life greatly extended by addition of the proper replenisher.

\*\*Water rinse between development and fixing.

F.S.—Full Strength.

S.S.—Stock Solution in separate bottles.

N.R.—Not Recommended.

Approximate roll film equivalents in determining useful life of processing solutions:

2 Rolls 127 = one 8 x 10 sheet      1 Roll 616 (116) = one and a half  
1 Roll 135 (36-exp.) = one 8 x 10 sheet      8 x 10 sheets  
1 Roll 620 (120) = one 8 x 10 sheet      1 Roll 122 = two 8 x 10 sheets

## KODAK CHEMICAL PREPARATIONS

THE Eastman Kodak Company makes available a variety of chemical preparations; including the most popular numbered formulas as well as several named preparations for which formulas are not published. These preparations provide a quick and easy means of making up dependable, efficient solutions, with assurance of purity, uniformity, and economy.

### DEVELOPERS

NAME	PRINCIPAL SIZES AVAILABLE	PURPOSE
Kodak Universal MQ Developer	12 oz for tray or 32 oz for tank	Convenient packet developer for films, plates, and papers
Kodak Versatol	8 and 16 oz, 1 and 5 gal Stock solution	Concentrated liquid universal developer for films, plates, and papers
Kodak Microdol	1 qt, 1, 5, 38, and 48 gal	Modern, improved fine-grain developer for films and plates
Kodak Microdol Replenisher	1 qt, 1 and 5 gal	Replenisher for Microdol Developer
Kodak Dektol	$\frac{1}{2}$ , 1, 5, 25, and 50 gal Stock solution	Improved, long life, D-72 type developer for films, plates, and papers
Kodak Selectol	$\frac{1}{2}$ , 1, 5, and 50 gal Stock solution	Improved D-52 type developer for warm-tone papers
Kodak Developer for Industrial and Recording Papers	5 quart	Developer for industrial and recording papers
Kodalith Developer	2 and 10 gal	Developer for Kodalith materials
Kodak Direct Positive Film Developing Outfit	1 quart size	Makes all necessary solutions for reversal processing Direct Positive Film
Kodak D-8	1, 5, and 25 gal	Extreme contrast: process materials
Kodak D-11	1, 5, 25, 50, and 100 gal	High contrast: films and plates
Kodak D-16	10 gal	Developer for motion picture positive film
Kodak D-19	1 and 3 $\frac{1}{2}$ gal	Rapid contrast developer
Kodak DK-50	1 and 3 $\frac{1}{2}$ gal	General use: films and plates
Kodak DK-50R	1 gal	Replenisher for Kodak DK-50
Kodak DK-60a	1, 3 $\frac{1}{2}$ , 10, 38, 48 gal	General use: films and plates
Kodak DK-60M	38 and 48 gal	Photofinishing machine development of roll films
Kodak DK-60aTR	1 and 5 gal	Replenisher for Kodak DK-60a: tank development
Kodak DK-60aMR	5 gal	Replenisher for Kodak DK-60a: machine development
Kodak D-76	1 quart $\frac{1}{2}$ , 1, and 10 gal	Low contrast, maximum shadow detail: panchromatic films and plates
Kodak D-76R	1 gal	Replenisher for Kodak D-76
Kodak D-88	1 gal	Developer, Kodak Direct Positive Paper
Kodak Direct Positive Paper Black-and-White Outfit	1 gal each of developer, bleach bath, and clearing bath	Makes all necessary solutions for reversal processing Direct Positive Paper to black and white prints



## OTHER PREPARATIONS

NAME	SIZES AVAILABLE	USE
Kodak Stop Bath with Indicator	1 gal	Dry powder to make acid rinse bath which turns color when exhausted
Kodak Tropical Hardener	1 gal	Chrome alum hardener rinse for high temperature processing of films and plates
Kodak Liquid Hardener	4 and 8 oz $\frac{1}{2}$ and 5 gal	Dilute to make hardening rinse or add to hypo solution to make hardening fixing bath
Kodak Acid Fixing Powder with Hardener	1 qt $\frac{1}{2}$ and 1 gal	Single powder fixing bath for films, plates, and papers
Kodak Photo-Fix	7 quarts	Fixer for photofinishing and commercial use. Two packages make 3 $\frac{1}{2}$ gallons
Kodak Rapid Liquid Fixer (with Hardener)	1, 5 and 20 gal	Rapid fixer for films and plates, supplied in convenient, concentrated liquid form
Kodak Testing Outfit for Stop Baths and Fixing Baths	1 oz of each test solution, 8 oz bottles	For determining when stop baths and fixing baths for films or papers are exhausted
Kodak Reducer and Stain Remover	16 oz each of two solutions	For reducing negatives and removing developer stains from negatives
Kodak Farmer's Reducer	1 quart	For reducing overexposed negatives
Kodak Chromium Intensifier	16 oz	For intensifying weak negatives
Kodak Sepia Toner	1 qt bleach 1 qt toner	Sepia toner for contact or projection prints, lantern slides, and transparencies
Kodak Rapid Selenium Toner	8 oz, 1 qt, 5 qts, 12 $\frac{1}{2}$ gal Stock solution	Concentrated single solution toner for cold brown permanent tones. Dilute 1 to 3 for use
Kodak Brown Toner	8 oz and 1 gal	Concentrated single solution toner for warm brown tones. Dilute 1 to 31 for use
Kodak Blue Toner	1 quart	Gold toner for blue-black to blue tones on prints. Also reddish tones on sepia prints
Kodak Hi-Temp Hardener	1 qt and 1 gal	Preliminary Hardener for processing at temperatures above normal
Kodak Hi-Temp Hardener Replenisher	1 qt and 1 gal	Replenisher for Hi-Temp Hardener
Kodak Anti-Fog No. 1	Tablets (0.45 gr) 1 oz, 4 oz, 1 lb	Antifoggant for use in developers
Kodak Anti-Fog No. 2	18 grains, 1 oz	For use in Preliminary Hardener SH-5
Kodak Anti-Cal	4 oz and 1 lb	For addition to developers for prevention of calcium scums, sludges and incrustations
Kodak Anti-Foam	1 and 16 oz	For prevention of foam on photographic solutions
Kodak Photo-Flo	5, 10 and 50 gal	To minimize water marks when drying films and to facilitate application of water colors, opaques, etc.
Kodak Ferrottype Plate Polish	8 oz	For polishing ferrottype plates to prevent sticking
Kodak Print Flattening Solution	8 oz 1 and 5 gal	To keep prints flexible and prevent curling
Kodak Desensitizer	8 oz (conc. solution) 1 and 5 grams (dry)	Preliminary desensitizing bath for negative materials
Kodak Rapid Mounting Cement	$\frac{1}{2}$ oz tube	Mounting photographic prints

## Kodak Developer D-7

*Elon-Pyro: For Professional Films and Plates*

### Stock Solution A

	Avoirdupois*	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Elon . . . . .	¼ ounce	7.5 grams
Kodak Sodium Bisulfite . . . . .	¼ ounce	7.5 grams
Kodak Pyro . . . . .	1 ounce	30.0 grams
Kodak Potassium Bromide . . . . .	60 grains	4.2 grams
Water to make . . . . .	32 ounces	1.0 liter

### Stock Solution B

Water . . . . .	32 ounces	1.0 liter
Kodak Sodium Sulfite, desiccated . . . . .	5 ounces	150. grams

### Stock Solution C

Water . . . . .	32 ounces	1.0 liter
Kodak Sodium Carbonate, desiccated . . . . .	2½ ounces	75.0 grams

Dissolve chemicals in the order given.

**Tray Development:** Take 1 part of A, 1 part of B, 1 part of C and 8 parts of water. Develop about 7 minutes at 68° F. (20° C.).

**Tank Development:** Take 1 part of A, 1 part of B, 1 part of C and 13 parts of water. Develop about 10 minutes at 68° F. (20° C.).

This developer can be used for two or three weeks if the volume is maintained by adding fresh developer in the proportion of 1 part each of A, B, and C to 4 parts of water. It is usually necessary to increase the development time as the developer ages.

## Kodak Developer D-8

*For Very High Contrast on Films and Plates*

### Stock Solution

	Avoirdupois	Metric
Water, about 90°F. (32°C.) . . . . .	24 ounces	750 cc.
Kodak Sodium Sulfite, desiccated . . . . .	3 ounces	90.0 grams
Kodak Hydroquinone . . . . .	1½ ounces	45.0 grams
Kodak Sodium Hydroxide (Caustic Soda) 1¼ ounces		37.5 grams
Kodak Potassium Bromide . . . . .	1 ounce	30.0 grams
Water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given. Stir the solution thoroughly before use.

For use, take 2 parts of stock solution and 1 part of water. Develop about 2 minutes in a tray at 68° F. (20° C.).

For general use, a developer which is slightly less alkaline and gives almost as much density can be obtained by using 410 grains of sodium hydroxide per 32 ounces of stock solution (28 grams per liter) instead of the quantity given in this formula.

\*Applies to solids only. Liquid quantities are U. S. Liquid Measure.

## Kodak Developer D-11

### For High Contrast on Films and Plates

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . .	16 ounces	500 cc.
Elon . . . . .	15 grains	1.0 gram
Kodak Sodium Sulfite, desiccated . . . .	2½ ounces	75.0 grams
Kodak Hydroquinone . . . . .	130 grains	9.0 grams
Kodak Sodium Carbonate, desiccated . .	365 grains	25.0 grams
Kodak Potassium Bromide . . . . .	73 grains	5.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

For process photography use without dilution. For development of copies of continuous-tone subjects, dilute with an equal volume of water. Develop about 5 minutes in a tank or 4 minutes in a tray at 68° F. (20° C.).

## Kodak Developer DK-15

### For Tropical Development of Films and Plates

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . .	24 ounces	750 cc.
Elon . . . . .	82 grains	5.7 grams
Kodak Sodium Sulfite, desiccated . . . .	3 ounces	90.0 grams
Kodalk . . . . .	¾ ounce	22.5 grams
Kodak Potassium Bromide . . . . .	27 grains	1.9 grams
*Kodak Sodium Sulfate, desiccated . . .	1½ ounces	45.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

\*If it is desired to use crystalline sodium sulfate instead of the desiccated sulfate then 3½ ounces per 32 ounces (105 grams per liter) should be used.

Dissolve chemicals in the order given.

Average time for tank development is about 10 minutes at 68° F. (20° C.) and 2 to 3 minutes at 90° F. (32° C.), in the fresh developer according to the contrast desired. When working *below* 75° F. (24° C.) the sulfate may be omitted if a more rapid formula is required. Development time *without* the sulfate is about 6 minutes at 68° F. (20° C.). Develop about 20 per cent less for tray use.

When development is completed rinse the film or plate in water for 1 or 2 seconds only and immerse in the Kodak Tropical Hardener or Kodak Hardening Bath SB-4 for 3 minutes (omit water rinse if film tends to soften); then fix for at least 10 minutes in an acid hardening fixing bath, such as Kodak Tropical Fixer or Kodak F-5, and was for 10 to 15 minutes in water (not over 95° F.) (35° C.).

Kodalk developers make it impossible to produce gas blisters, because Kodalk does not evolve a gas when treated with an acid. This is a distinct advantage, especially for summer work, when temperature control of solutions is often difficult.

## Kodak Developer DK-15a

### For Low Contrast Tropical Development of Films and Plates

A developer which gives less contrast than Kodak DK-15 can be obtained by reducing the quantity of Kodalk in DK-15 to 73 grains per 32 ounces of developer (5 grams per liter).

Development times and processing instructions are the same as for Kodak Developer DK-15 above.

## Kodak Developer D-19

### *For Rapid Development of Films and Plates*

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F. (50°C.) . . . .	16 ounces	500 cc.
Elon . . . . .	32 grains	2.2 grams
Kodak Sodium Sulfite, desiccated . . . .	3 oz. 90 grains	96.0 grams
Kodak Hydroquinone . . . . .	128 grains	8.8 grams
Kodak Sodium Carbonate, des. . . . .	1 oz. 265 grains	48.0 grams
Kodak Potassium Bromide . . . . .	73 grains	5.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Develop about 6 minutes in a tank or 5 minutes in a tray at 68° F. (20° C.) according to the contrast desired.

## Kodak Replenisher D-19R

### *For Use with Kodak Developer D-19*

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F. (50°C.) . . . .	16 ounces	500 cc.
Elon . . . . .	64 grains	4.4 grams
Kodak Sodium Sulfite, desiccated . . . .	3 oz. 90 grains	96.0 grams
Kodak Hydroquinone . . . . .	260 grains	17.6 grams
Kodak Sodium Carbonate, des. . . . .	1 oz. 265 grains	48.0 grams
Kodak Sodium Hydroxide . . . . .	1/4 ounce	7.5 grams
Water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Use without dilution and add to the developer tank in the proportion of 1 ounce of Kodak D-19R per 100 square inches of film processed (about 25 cc. per each 8 x 10-inch film). The maximum volume of replenisher added should not be greater than the volume of the original developer.

## Kodak Fine Grain Developer DK-20

### For Films and Plates

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . .	96 ounces	750 cc.
Elon . . . . .	290 grains	5.0 grams
Kodak Sodium Sulfite, desiccated . . .	13¼ ounces	100.0 grams
Kodalk . . . . .	116 grains	2.0 grams
Kodak Sodium Thiocyanate (Sulfocyanate) . . . . .	58 grains	1.0 gram
Kodak Potassium Bromide . . . . .	29 grains	0.5 gram
Cold water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

Average development time about 15 minutes in a tank at 68° F. (20° C.). See individual recommendations listed for each material.

The useful life of this developer can be increased 5 to 10 times by use of the following replenisher.

## Kodak Replenisher DK-20R

### For Kodak Fine Grain Developer DK-20

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . .	96 ounces	750 cc.
Elon . . . . .	1 ounce	7.5 grams
Kodak Sodium Sulfite, desiccated . . .	13¼ ounces	100.0 grams
Kodalk . . . . .	2 oz. 290 grains	20.0 grams
Kodak Sodium Thiocyanate (Sulfocyanate) . . . . .	290 grains	5.0 grams
Kodak Potassium Bromide . . . . .	58 grains	1.0 gram
Cold water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

**Deep Tank Use:** The replenisher should be added at a rate which will maintain constant development activity. Ordinarily this will be achieved by adding 6 gallons per 1000 rolls processed (approximately 80,000 square inches) or  $\frac{3}{4}$  ounce per roll. In many cases this volume of replenisher will coincide with the quantity of developer lost through use. In other cases it may be necessary also to remove some exhausted developer or to add fresh developer in addition to the replenisher to maintain constant level in the tank.

The replenisher should be added frequently and stirred in thoroughly after every batch of films or after not more than 4 rolls (320 square inches) have been processed per gallon of developer.

**Smaller Tanks:** After processing one roll of film (80 square inches) add one ounce of replenisher solution to the empty Kodak Developer DK-20 stock solution bottle. Then pour enough used developer into the bottle to fill it to the original volume; discard any excess. If short of the original volume, add unused Kodak Developer DK-20 to make up loss. Repeat for each roll developed.

## Kodak Developer D-23

### Low-Contrast Developer for Roll Film, Sheet Film, and Plates

	Avoirdupois U.S. Liquid	Metric
Water, about 125°F. (50°C.)	24 ounces	750 cc.
Elon	¼ ounce	7.5 grams
Kodak Sodium Sulfite, desiccated	3 oz. 145 grains	100.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Average development time about 19 minutes in a tank or 15 minutes in a tray at 68° F. (20° C.).

The life of the developer can be extended by using Kodak Replenisher DK-25R. Add the replenisher at the rate of 6 gallons per 1000 rolls of film processed ( $\frac{3}{4}$  oz. per roll). The developer should be discarded after about 100 rolls (8,000 square inches) of film have been developed per gallon.

## Kodak Developer D-25

### Fine-Grain Developer for Roll Film, Sheet Film, and Plates

	Avoirdupois U.S. Liquid	Metric
Water, about 125°F. (50°C.)	24 ounces	750 cc.
Elon	¼ ounce	7.5 grams
Kodak Sodium Sulfite, desiccated	3 oz. 145 grains	100.0 grams
Kodak Sodium Bisulfite	½ ounce	15.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Average development time for Kodak Roll Films, about 35 minutes in a tank at 68° F. (20° C.). At 77° F. (25° C.) the average development time is about 18 minutes in a tank and the properties are approximately the same as those of Kodak DK-20 at 68° F. (20° C.). Grain is comparable with that obtained with the popular parphenylenediamine type of developer, but Kodak D-25 is non-toxic and non-staining.

If it is not essential to obtain minimum graininess, or if it is not convenient to work at the higher temperature, use half the specified quantity of sodium bisulfite. The development time will then be approximately 24 minutes at 68° F. (20° C.). Graininess is intermediate between that for Kodak D-23 and that for Kodak D-25.

For replenishment, add Kodak Replenisher DK-25R at the rate of 10 gallons per 1000 rolls ( $1\frac{1}{4}$  ounces per roll) for the first 50 rolls per gallon of developer, and at 6 gallons per 1000 rolls ( $\frac{3}{4}$  ounce per roll) for the second 50 rolls per gallon. The developer should then be replaced with a fresh solution.

## Kodak Replenisher DK-25R

### For Use with Kodak Developers D-23 and D-25

	Avoirdupois U.S. Liquid	Metric
Water, about 125°F. (50°C.)	24 ounces	750 cc.
Elon	145 grains	10.0 grams
Kodak Sodium Sulfite, desiccated	3 oz. 145 grains	100.0 grams
Kodalk	290 grains	20.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

## Kodak Developer D-32

### For Warm Tones on Lantern Slide Plates, Medium

#### Stock Solution A

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Kodak Sodium Sulfite, desiccated . . . . .	90 grains	6.3 grams
Kodak Hydroquinone . . . . .	100 grains	7.0 grams
Kodak Potassium Bromide . . . . .	50 grains	3.5 grams
Kodak Citric Acid . . . . .	10 grains	0.7 gram
Cold water to make . . . . .	32 ounces	1.0 liter

#### Stock Solution B

Cold water . . . . .	32 ounces	1.0 liter
Kodak Sodium Carbonate, desiccated . . . . .	1 ounce	30.0 grams
Kodak Sodium Hydroxide (Caustic Soda) . . . . .	60 grains	4.2 grams

Dissolve chemicals in the order given.

For use, take 1 part of A and 1 part of B. For still warmer tones, 1 part of A and 2 parts of B. Stir thoroughly before use. Develop about 5 minutes in a tray at 68° F. (20° C.).

## Kodak Developer DK-50

### For Professional Films and Plates

#### Stock Solution

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F. (50°C.) . . . . .	64 ounces	500 cc.
Elon . . . . .	145 grains	2.5 grams
Kodak Sodium Sulfite, desiccated . . . . .	4 ounces	30.0 grams
Kodak Hydroquinone . . . . .	145 grains	2.5 grams
Kodalk . . . . .	1 oz. 145 grains	10.0 grams
Kodak Potassium Bromide . . . . .	29 grains	0.5 gram
Water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

For tank development of portrait negatives, dilute with an equal volume of water; develop about 8 minutes at 68° F. (20° C.). For tray development, use without dilution; develop about 4 minutes at 68° F. (20° C.).

For commercial work, use without dilution. Develop about 8 minutes in a tank or 6 minutes in a tray at 68° F. (20° C.).

## Kodak Replenisher DK-50R

### For Kodak Developer DK-50

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F. (50°C.) . . . . .	96 ounces	750 cc.
Elon . . . . .	290 grains	5.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	4 ounces	30.0 grams
Kodak Hydroquinone . . . . .	1 oz. 145 grains	10.0 grams
Kodalk . . . . .	5¼ ounces	40.0 grams
Water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

Add to the developer to maintain the activity constant, as described in the instructions for Kodak Replenisher DK-20R.

If the developer is diluted 1 to 1 for use, the replenisher should be diluted in the same proportion.

## Kodak Developer D-52

### For Warm Tone Papers

#### Stock Solution

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C) . . . . .	16 ounces	500 cc.
Elon . . . . .	22 grains	1.5 grams
Kodak Sodium Sulfite, desiccated . . . . .	¾ ounce	22.5 grams
Kodak Hydroquinone . . . . .	90 grains	6.3 grams
Kodak Sodium Carbonate, desiccated . . . . .	½ ounce	15.0 grams
Kodak Potassium Bromide . . . . .	22 grains	1.5 grams
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

For use, take 1 part of stock solution to 1 part of water. Develop about 2 minutes at 68° F (20° C).

Note: More bromide may be added if warmer tones are desired.

## Kodak Developer DK-60a

### For Photofinishing and Professional Photography

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C) . . . . .	96 ounces	750 cc.
Elon . . . . .	145 grains	2.5 grams
Kodak Sodium Sulfite, desiccated . . . . .	6¾ oz.	50.0 grams
Kodak Hydroquinone . . . . .	145 grains	2.5 grams
Kodalk . . . . .	2 oz. 290 grains	20.0 grams
Kodak Potassium Bromide . . . . .	29 grains	0.5 gram
Water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

Average development time for deep tank about 7 minutes at 68° F (20° C).

See individual recommendations listed for each material.

## Kodak Replenisher DK-60aTR

### For Deep Tank (Hand Processing) with Kodak Developer DK-60a

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C) . . . . .	96 ounces	750 cc.
Elon . . . . .	290 grains	5.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	6¾ oz.	50.0 grams
Kodak Hydroquinone . . . . .	1 oz. 145 grains	10.0 grams
Kodalk . . . . .	5 oz. 145 grains	40.0 grams
Cold water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

Add to the developer tank according to the general instructions for Kodak Replenisher DK-20R. The development time will be maintained approximately constant, provided 8 gallons of replenisher (Kodak DK-60aTR) are added per 1000 rolls of film processed (80,000 square inches).

## Kodak Replenisher DK-60aMR

### For Automatic Machine Processing with Kodak Developer DK-60a

For automatic machine processing, when less developer is carried out of the tank by the film than with hand processing, the replenisher Kodak DK-60aMR should be used, which is available only in package form.

See the instructions for Kodak Replenisher DK-20R.



## Kodak Developer D-61a

### For Professional Films and Plates

#### Stock Solution

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Elon . . . . .	45 grains	3.1 grams
Kodak Sodium Sulfite, desiccated . . . . .	3 ounces	90.0 grams
Kodak Sodium Bisulfite . . . . .	30 grains	2.1 grams
Kodak Hydroquinone . . . . .	85 grains	5.9 grams
Kodak Sodium Carbonate, desiccated . . . . .	165 grains	11.5 grams
Kodak Potassium Bromide . . . . .	24 grains	1.7 grams
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

**Tray Development:** Take 1 part of stock solution to 1 part of water. Develop about 6 minutes at 68° F. (20° C.).

**Tank Development:** Take 1 part of stock solution and 3 parts of water. Develop about 12 minutes at 68° F. (20° C.). Add stock solution (diluted 1:3) at intervals to maintain the volume, or the replenisher, Kodak D-61R, to maintain the strength of the solution.

## Kodak Replenisher D-61R

### For Kodak Developer D-61a

#### Stock Solution A

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	96 ounces	3.0 liters
Elon . . . . .	85 grains	5.9 grams
Kodak Sodium Sulfite, desiccated . . . . .	6 ounces	180.0 grams
Kodak Sodium Bisulfite . . . . .	55 grains	3.8 grams
Kodak Hydroquinone . . . . .	170 grains	11.9 grams
Kodak Potassium Bromide . . . . .	45 grains	3.1 grams
Cold water to make . . . . .	1½ gallons	6.0 liters

#### Stock Solution B

Kodak Sodium Carbonate, desiccated . . . . .	8 ounces	240.0 grams
Water to make . . . . .	64 ounces	2.0 liters

Dissolve chemicals in the order given.

For use take 3 parts of A and 1 part of B and add to the tank of developer as needed. Do not mix solutions A and B until ready to use.

## Kodak Developer D-72

### For Papers, Films, and Plates

#### Stock Solution

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Elon . . . . .	45 grains	3.1 grams
Kodak Sodium Sulfite, desiccated . . . . .	1½ ounces	45.0 grams
Kodak Hydroquinone . . . . .	175 grains	12.0 grams
Kodak Sodium Carbonate, desiccated . . . . .	2¼ ounces	67.5 grams
Kodak Potassium Bromide . . . . .	27 grains	1.9 grams
Water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

For dilution and development times, see individual recommendations listed for each material.

## Kodak Developer D-76

### Maximum Speed at Normal Contrast on Films and Plates

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	24 ounces	750 cc.
Elon . . . . .	29 grains	2.0 grams
Kodak Sodium Sulfite, desiccated 3 oz.	145 grains	100.0 grams
Kodak Hydroquinone . . . . .	73 grains	5.0 grams
Kodak Borax, granular . . . . .	29 grains	2.0 grams
Water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Average development time about 17 minutes at 68° F. (20° C.). See individual recommendations listed for each material.

The useful life of this developer can be increased 5 to 10 times by use of the Kodak Replenisher D-76R.

A faster working developer can be obtained by increasing the quantity of borax. By increasing the borax quantity ten times, from 29 grains to 290 grains per 32 ounces (from 2 grams to 20 grams per liter), the development time will be about one-half that of regular Kodak D-76. Maximum activity can be obtained by substituting Kodalk for the borax as given in the table below.

## Kodak Replenisher D-76R

### For Kodak Developer D-76

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	24 ounces	750 cc.
Elon . . . . .	44 grains	3.0 grams
Kodak Sodium Sulfite, desiccated 3 oz.	145 grains	100.0 grams
Kodak Hydroquinone . . . . .	1/4 ounce	7.5 grams
Kodak Borax, granular . . . . .	290 grains	20.0 grams
Water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Use the replenisher without dilution and add to the tank to maintain the activity of the developer as described for Kodak Replenisher DK-20R.

When Kodalk is substituted for borax in formula Kodak D-76, and a replenisher is required, it is necessary to substitute Kodalk for borax in Kodak D-76R as follows:

Kodalk In Kodak D-76		Time of Tank Development	Kodalk in Kodak D-76R	
Per Liter	Per 32 Ounces		Per Liter	Per 32 Ounces
2 grams	29 grains	16 minutes	7.5 grams	1/4 ounce
5 grams	73 grains	8 minutes	20.0 grams	290 grains
10 grams	145 grains	6 minutes	40.0 grams	1 oz. 145 grains
20 grams	290 grains	4 minutes	*40.0 grams	1 oz. 145 grains

\*Discard some developer before adding replenisher.

## Kodak Developer D-82

### For Extreme Underexposures

	Avoirdupois U.S. Liquid	Metric
Water, about 125°F. (50°C.) . . . . .	24 ounces	750 cc.
Kodak Wood Alcohol . . . . .	1½ ounces	48.0 cc.
Elon . . . . .	200 grains	14.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	1¾ ounces	52.5 grams
Kodak Hydroquinone . . . . .	200 grains	14.0 grams
Kodak Sodium Hydroxide (Caustic Soda) . . . . .	125 grains	8.8 grams
Kodak Potassium Bromide . . . . .	125 grains	8.8 grams
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Develop about 5 minutes in a tray at 68° F. (20° C.).

The prepared developer does not keep more than a few days in a full bottle or about 2 hours in an open tray. If wood alcohol is omitted and the developer is diluted, the solution is not so active as in the concentrated form.

## Kodak Developer D-85

### For Kodalith Films, Plates, and Papers

	Avoirdupois U.S. Liquid	Metric
Water, about 90°F. (30°C.) . . . . .	64 ounces	500 cc.
Kodak Sodium Sulfite, desiccated . . . . .	4 ounces	30.0 grams
Kodak Paraformaldehyde . . . . .	1 ounce	7.5 grams
Kodak Sodium Bisulfite . . . . .	128 grains	2.2 grams
*Kodak Boric Acid, crystals . . . . .	1 ounce	7.5 grams
Kodak Hydroquinone . . . . .	3 ounces	22.5 grams
Kodak Potassium Bromide . . . . .	90 grains	1.6 grams
Water to make . . . . .	1 gallon	1.0 liter

\*Use crystalline boric acid as specified. Powdered boric acid dissolves with great difficulty and its use should be avoided.

#### Mixing Directions

Use a one-gallon narrow-mouthed bottle for mixing the developer. First check the volume of the bottle and mark it to indicate the exact level of one gallon of solution. Fill the bottle half full of water at about 90° F. (32° C.) and dissolve the chemicals in the order given. After adding each chemical, place the stopper in the bottle so that only a small quantity of air is present during agitation. When all the chemicals have been dissolved, add cold water until the solution comes up to the one-gallon mark. Insert the stopper tightly to exclude as much air as possible. Allow the developer to stand about two hours after mixing. Cool to 68° F. (20° C.) before use. If only a portion of the contents of the bottle is used at one time, it is suggested that the balance be saved by filling a bottle of smaller size which should then be stoppered tightly.

Time of Development: 1½ to 2 minutes at 68° F. (20° C.); see individual recommendations given for each material. With a correctly timed exposure, the image should appear in 30 to 45 seconds at the temperature specified.

This developer has the property of cutting off development very sharply in the low densities thus insuring clear dot formation in the halftone negatives.

## PROCESSING KODAK SUPER-SPEED DIRECT POSITIVE PAPER

The steps in processing exposed Kodak Direct Positive Paper are as follows:

1. Development of negative
2. Bleaching of negative
3. Clearing
4. Re-expose to light
5. Redevelopment
6. Fixing (if desired, but not necessary)

Wash well in running water for at least 15 seconds between the various solutions.

For black-and-white prints re-expose to artificial light or daylight and redevelop in Kodak Developer D-88 for 30 seconds at 68° F (20° C). The white light can be turned on as soon as the prints are in the clearing bath, or the prints can be exposed for 2 or 3 seconds to a 40 or 60-watt lamp at a distance of 6 to 8 inches. To obtain prints of slightly greater brilliancy fix for about 30 seconds (Kodak F-1) after redevelopment, and then wash for at least 10 minutes to insure removal of the hypo.

If brown tones are desired, redevelop in Kodak Odorless Sepia Toner or Kodak Sulfide Redeveloper T-19. It is not necessary to re-expose the paper before redevelopment. Fixing is not necessary.

### Kodak Developer D-88

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C)	96 ounces	750 cc.
Kodak Sodium Sulfite, desiccated	6½ ounces	48.8 grams
Kodak Hydroquinone	3¼ ounces	24.4 grams
*Kodak Boric Acid, crystals	¾ ounce	5.6 grams
Kodak Potassium Bromide	150 grains	2.6 grams
**Kodak Sodium Hydroxide (Caustic Soda)	3¼ ounces	24.4 grams
Cold water to make	1 gallon	1.0 liter

\*Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

\*\***Caution:** Dissolve the caustic soda in a small volume of water in a separate container and then add it to the solution of the other constituents. Then dilute the whole to the required volume. If a glass container is employed in dissolving the caustic soda, the solution should be stirred constantly until the soda is dissolved, to prevent cracking the glass by the heat evolved.

Dissolve chemicals in the order given.

Use full strength at 68° F (20° C). Develop 45 seconds to 1 minute.

### Kodak Bleaching Bath R-9

	Avoirdupois U. S. Liquid	Metric
Water	1 gallon	1.0 liter
Kodak Potassium Bichromate	1¼ ounces	9.4 grams
*Kodak Sulfuric Acid	1½ ounces	12.0 cc.

\***Caution:** Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

Use full strength at 68° F (20° C) for about 30 seconds. For more rapid bleaching, however, the quantities of acid and bichromate may be increased.

### Kodak Clearing Bath CB-1

	Avoirdupois U. S. Liquid	Metric
Kodak Sodium Sulfite, desiccated	12 ounces	90.0 grams
Water to make	1 gallon	1.0 liter

Use full strength at 68° F (20° C) for about 30 seconds.

### Kodak Sulfide Redeveloper T-19

	Avoirdupois U. S. Liquid	Metric
Kodak Sodium Sulfide, (not Sulfite).	290 grains	20.0 grams
Water to make	32 ounces	1.0 liter

Use full strength at 68° F (20° C) for about 30 seconds.

## Kodak Developer DK-93

*Kodolon: For Films, Plates, and Papers*

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Kodolon . . . . .	73 grains	5.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	1 ounce	30.0 grams
Kodak Hydroquinone . . . . .	37 grains	2.5 grams
Kodalk . . . . .	290 grains	20.0 grams
Kodak Potassium Bromide . . . . .	7 grains	0.5 gram
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

Use without dilution. Develop roll films about 9 minutes in a tank of fresh developer at 68° F. (20° C.). Develop professional films and plates about 6 minutes at 68° F. (20° C.). Greater or less contrast may be obtained by developing longer or shorter times than those specified.

For warm tones on papers, use without dilution and develop for 2 minutes at 68° F. (20° C.). For colder tones, double the quantity of Kodalk; use without dilution and develop 1 to 2 minutes at 68° F. (20° C.). In either case, the tones given with this developer are slightly warmer than the normal tones given with Kodak Developers D-52 and D-72.

The use of Kodak DK-93 is especially recommended for those persons subject to trouble from skin irritation.

# STOP AND HARDENING BATHS

## Kodak Stop Bath SB-1

### For Papers

	U. S. Liquid	Metric
Water . . . . .	32 ounces	1.0 liter
*Kodak Acetic Acid, 28% . . . . .	1½ ounces	48.0 cc.

\*To make approximately 28% acetic acid from glacial acetic acid dilute three parts of glacial acetic acid with eight parts of water.

Rinse prints for at least 5 seconds. Capacity: about 20 8 x 10-inch prints per quart (liter).

## Kodak Stop Bath SB-1a

### For Films, Plates, and Papers for Graphic Arts

	U. S. Liquid	Metric
Water . . . . .	32 ounces	1.0 liter
*Kodak Acetic Acid, 28% . . . . .	4 ounces	125.0 cc.

\*To make approximately 28% acetic acid from glacial acetic acid dilute three parts of glacial acetic acid with eight parts of water.

The action of this bath checks development instantly, provided the acid has not been neutralized. It also tends to prevent uneven spots and streaks when the prints or negatives are immersed in the fixing bath.

## Kodak Hardening Bath SB-3

### For Use at 65° to 75°F. with Films and Plates

	Avoirdupois	Metric
	U. S. Liquid	
Water . . . . .	32 ounces	1.0 liter
Kodak Potassium Chrome Alum . . . . .	1 ounce	30.0 grams

This bath is intended for use in hot weather after development and before fixation in conjunction with Kodak Fixing Bath F-5.

Agitate the negatives for a few seconds when first immersed in hardener. Leave them in the bath for 3 to 5 minutes to secure maximum hardening. This bath should be renewed frequently.

## TO MAKE 28% ACETIC ACID

Kodak formulas specify 28 per cent acetic acid, which can be measured more conveniently and accurately and is less likely to cause trouble in mixing, than the high concentrations which are also available commercially. If the acid is purchased in higher concentration, before use it should be diluted to approximately 28 per cent as follows:

Original Strength	Glacial	80%	56%
Parts of acid . . . . .	3	5	1
Parts of water . . . . .	8	9	1

## Kodak Hardening Bath SB-4

*For Use at 75° to 90°F. with Films and Plates*

This solution is recommended for use in conjunction with the High Temperature Developer (Kodak DK-15), when working above 75° F. (24° C.).

	Avoirdupois	Metric
Water . . . . .	32 ounces	1.0 liter
Kodak Potassium Chrome Alum . .	1 ounce	30.0 grams
*Kodak Sodium Sulfate, desiccated . .	2 ounces	60.0 grams

\*If crystalline Sodium Sulfate is preferred instead of the desiccated, use  $4\frac{1}{2}$  ounces (140 grams) in the above formula.

Agitate the negatives for 30 to 45 seconds when they are first immersed in the hardener, or streakiness will result. Leave them in the bath for at least 3 minutes between development and fixation. If the temperature is below 85° F. (29° C.) rinse for 1 to 2 seconds in water before immersing in the hardener bath.

The hardening bath is a violet blue color by tungsten light when freshly mixed, but it ultimately turns a yellow-green with use; it then ceases to harden and should be replaced with a fresh bath. The hardening bath should never be overworked. An unused bath will keep indefinitely, but the hardening power of a partially used bath decreases rapidly on standing for a few days.

## Kodak Stop Bath SB-5

*Nonswelling Acid Rinse for Photofinishing*

	Avoirdupois	Metric
Water . . . . .	16 ounces	500 cc.
*Kodak Acetic Acid 28% . . . . .	1 fluid oz.	32.0 cc.
**Kodak Sodium Sulfate, desiccated . .	$1\frac{1}{2}$ ounces	45.0 grams
Water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 28 % acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

\*\*If crystalline Sodium Sulfate is preferred instead of the desiccated sulfate, use  $3\frac{1}{2}$  ounces per 32 ounces of solution (105 grams per liter) in the above formula.

Agitate the films when first immersed in this bath and allow them to remain about three minutes before transfer to the fixing bath.

This bath should be replaced after approximately 25 rolls have been processed per quart (liter), when about 24 ounces (720 cc.) of developer will have been carried into the rinse bath by the film.

## Kodak Special Hardener SH-1

*For After Treatment of Films and Plates*

	Avoirdupois	Metric
Water . . . . .	16 ounces	500 cc.
Kodak Formaldehyde (about 37% solution by weight) . . . . .	$2\frac{1}{2}$ drams	10.0 cc.
Kodak Sodium Carbonate, desiccated .	73 grains	5.0 grams
Water to make . . . . .	32 ounces	1.0 liter

This formula is recommended for the treatment of negatives which normally would be softened by a chemical treatment as for the removal of stains or for intensification or reduction.

After hardening for three minutes, negatives should be rinsed and immersed for five minutes in a fresh acid fixing bath and then washed thoroughly before they are given any further chemical treatment.

## Kodak Prehardener SH-5

### Solution A

		Avoirdupois U.S. Liquid	Metric
Kodak Formaldehyde, about 37% solution by weight . . . . .		1¼ drams	5 cc.

### Solution B

Water . . . . .	28 ounces	900 cc.
*0.5% solution of Kodak Anti-Fog No. 2 (6-Nitrobenzimidazole Nitrate) . . . . .	1¼ ounces	40.0 cc.
Kodak Sodium Sulfate, desiccated 1 oz. 290	grains	50.0 grams
Kodak Sodium Carbonate, desiccated . 145	grains	10.0 grams
Water to make . . . . .	32 ounces	1.0 liter

\*To prepare an 0.5% solution, dissolve 18 grains of Kodak Anti-Fog No. 2 in 8 ounces of distilled water (1 gram in 200 cc. of water).

**Directions for Mixing:** The working solution should be prepared just before using by adding 1¼ drams (5 cc.) of Solution A to 32 ounces (1 liter) of Solution B and mixing thoroughly.

**Directions for Use:** Bathe the exposed film in the Prehardener, Kodak SH-5, for 10 minutes with moderate agitation. Then remove the film from the solution, drain for a few seconds, immerse in water for 30 seconds, drain thoroughly and immerse in the developer. The selection of the proper developer will depend upon the contrast and the time of development desired. In general, up to 90° F, (32° C) conventional developers such as Kodak D-76, DK-60a, D-19, etc., may be used without modification.

Times of development will be about as follows:

At 75° F (24° C)—use the normal developing time recommended at 68° F (20° C) without prehardening.

At 80° F (27° C)—85% of normal time.

At 85° F (29° C)—70% of normal time.

At 90° F (32° C)—60% of normal time.

At 95° F (35° C)—50% of normal time.

Following development, rinse, fix in an acid hardening fixing bath, wash, and dry in the usual way.

### At Temperatures Above 95° F (35° C)

Increase the concentration of Kodak Anti-Fog No. 2 in the Prehardener up to double the normal formula concentration, if necessary, to control fog. Process as before, using a low-activity developer, such as Kodak D-76, to avoid excessively short developing times. The average developing time at 110° F (43° C) after prehardening is about one-quarter of the normal time at 68° F.

In case the development time at elevated temperatures is too short for practical use, sodium sulfate can be added to the developer to extend the time of development.

**Keeping Properties:** The keeping properties are adequate for ordinary tray and tank practice. Gradual deterioration does occur on standing but the bath will keep satisfactorily (without use) in a closed bottle for 3 or 4 weeks at 95° F (35° C). For most applications the useful life without replenishment is more than forty 8 x 10-inch films per gallon without serious change in properties. With suitable replenishment the sensitometric and hardening characteristics may be maintained satisfactorily constant for several weeks and approximately 200 8 x 10-inch films per gallon can be processed. Replenish at the rate of approximately 1 oz. per roll (80 square inches) with Kodak Replenisher SH-5R.



## Kodak Replenisher SH-5R

### For Kodak Prehardener SH-5

For use when carry-over approximates one ounce (30 cc.) per 8 x 10-inch film.

#### Solution A

	Avoirdupois U.S. Liquid	Metric
Kodak Formaldehyde, about 37% solution by weight . . . . .	2 drams	8.0 cc.

#### Solution B

Water . . . . .	28 ounces	900.0 cc.
*0.5% solution of Kodak Anti-Fog No. 2 (6-Nitrobenzimidazole Nitrate) . . . . .	1¾ ounces	55.0 cc.
Kodak Sodium Sulfate, desiccated 1 oz. 290 grains		50.0 grams
Kodak Sodium Carbonate, desiccated . . . . .	¾ ounce	22.5 grams
Water to make . . . . .	32 ounces	1.0 liter

\*To prepare a 0.5% solution, dissolve 18 grains of Kodak Anti-Fog No. 2 in 8 ounces of distilled water (1 gram in 200 cc. of water).

**Directions for Mixing:** The two solutions should be mixed just before using.

**Directions for Use:** For tank use, maintain the original level of the Prehardener solution by periodic additions of the replenisher. For tray use, mark the original solution level on the storage bottle and, when the solution has been returned to this bottle after use, fill up to the mark with the replenisher solution.

**Replenishment of Developer:** Since the prehardening and rinsing treatments wet the film before it enters the developer, the volume of water thus introduced dilutes the developer and balances the quantity of solution subsequently carried out. Therefore, it is necessary to discard enough developer solution to allow addition of replenisher. The usual developer replenisher can be used, allowing 1½ ounces (45 cc.) of replenisher for each 80 square inches of film processed. This can be estimated as 1½ times the volume of replenisher added to the prehardener.

# FIXING BATHS

## Kodak Fixing Bath F-1

### For Papers

	Avoirdupois	Metric
Water . . . . .	64 ounces	2.0 liters
Kodak Sodium Thiosulfate (Hypo) . . . . .	16 ounces	480.0 grams

When the hypo is dissolved completely, add the following hardener solution slowly to the cool hypo solution while stirring the latter rapidly.

Water, about 125°F (50°C) . . . . .	5 ounces	160 cc.
Kodak Sodium Sulfite, desiccated . . . . .	1 ounce	30.0 grams
*Kodak Acetic Acid, 28% . . . . .	3 fluid oz.	96.0 cc.
Kodak Potassium Alum . . . . .	1 ounce	30.0 grams

\*To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

Dissolve the chemicals in the order given. The sodium sulfite should be dissolved completely before the acetic acid is added. After the sulfite-acid solution has been mixed thoroughly, add the potassium alum with constant stirring. Fix prints 5 to 10 minutes.

If it is desired to store this hardener as a stock solution (Kodak Hardener F-1a) add cold water to the above quantities to make 16 oz. or 500 cc. of hardener solution. For use, add 1 part of cool stock hardener solution slowly to 4 parts of a 25% cool hypo solution (2 pounds of hypo to the gallon of solution). If the hypo is not thoroughly dissolved before adding the hardener a precipitate of sulfur is likely to form.

## Kodak Fixing Bath F-5

### For Films, Plates, and Papers

The Kodak Fixing Bath F-5 has the advantage over the older type of fixing baths, which do not contain boric acid, that it gives much better hardening and has less tendency to precipitate a sludge of aluminum sulfite.

In warm weather and in inadequately ventilated darkrooms the odor of sulfur dioxide given off by the Kodak Fixing Bath F-5 may be objectionable. This can be eliminated almost entirely by omitting the boric acid and substituting twice its weight in Kodalk. This modification is known as Kodak Fixing Bath F-6.

	Avoirdupois	Metric
Water, about 125°F (50°C) . . . . .	20 ounces	600 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	8 ounces	240.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	½ ounce	15.0 grams
*Kodak Acetic Acid, 28% . . . . .	1½ fluid oz.	48.0 cc.
**Kodak Boric Acid, crystals . . . . .	¼ ounce	7.5 grams
Kodak Potassium Alum . . . . .	½ ounce	15.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

\*\*Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Films or plates should be fixed properly in 10 to 20 minutes in a freshly prepared bath. The bath need not be discarded until the fixing time becomes excessive, that is, over 20 minutes. Fix prints 5 to 10 minutes.

The hardener may also be mixed separately as a stock solution as follows:

## Kodak Hardener F-5a

### Stock Solution For Preparing Kodak Fixing Bath F-5

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	20 ounces	600 cc.
Kodak Sodium Sulfite, desiccated . . . . .	2½ ounces	75.0 grams
*Kodak Acetic Acid, 28% . . . . .	7½ fluid oz.	235.0 cc.
**Kodak Boric Acid, crystals . . . . .	1¼ ounces	37.5 grams
Kodak Potassium Alum . . . . .	2½ ounces	75.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

\*\*Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Dissolve chemicals in order given.

Add one part of the cool stock hardener solution slowly to 4 parts of cool 30% hypo solution (2½ pounds per gallon of solution), while stirring the hypo rapidly.

## Kodak Fixing Bath F-6

### Odorless Bath for Films, Plates, and Papers

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	20 ounces	600 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	8 ounces	240.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	½ ounce	15.0 grams
*Kodak Acetic Acid, 28% . . . . .	1½ fluid oz.	48.0 cc.
Kodalk . . . . .	½ ounce	15.0 grams
Kodak Potassium Alum . . . . .	½ ounce	15.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

Dissolve chemicals in the order given

This bath should be used in conjunction with a stop bath such as Kodak SB-1 or SB-1a, or an acid hardening bath such as Kodak SB-3 to obtain the full useful hardening life. The hardening life (capacity) is equal to that of Kodak F-5 provided an acid stop bath is used. With a water rinse the life is about one-half that of Kodak F-5.

The hardener may also be mixed separately as a stock solution as follows:

## Kodak Hardener F-6a

### Stock Solution For Preparing Kodak Fixing Bath F-6

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	20 ounces	600 cc.
Kodak Sodium Sulfite, desiccated . . . . .	2½ ounces	75.0 grams
*Kodak Acetic Acid, 28% . . . . .	7½ fluid oz.	235.0 cc.
Kodalk . . . . .	2½ ounces	75.0 grams
Kodak Potassium Alum . . . . .	2½ ounces	75.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

Dissolve chemicals in the order given.

Add one part of the cool stock hardener solution slowly to four parts of cool 30% hypo solution (2½ pounds per gallon of solution), while stirring the hypo rapidly.

## Kodak Rapid Fixing Bath F-7

### For General Photographic Use

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C) . . . . .	80 ounces	600 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	3 pounds	360.0 grams
Kodak Ammonium Chloride . . . . .	6¾ ounces	50.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	2 ounces	15.0 grams
*Kodak Acetic Acid, 28% . . . . .	6 fluid oz.	48.0 cc.
**Kodak Boric Acid, crystals . . . . .	1 ounce	7.5 grams
Kodak Potassium Alum . . . . .	2 ounces	15.0 grams
Cold water to make . . . . .	1 gallon	1.0 liter

\*To make approximately 28 % acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with 8 parts of water.

\*\*Use crystalline boric acid as specified. Powdered boric acid dissolves only with great difficulty and its use should be avoided.

Dissolve chemicals in the order given.

This bath fixes much more rapidly than Kodak F-5 or F-6, and its useful fixing capacity is considerably greater.

The stock hardener solution Kodak F-5a can be used in making up a similar rapid fixing bath, as follows:

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C) . . . . .	64 ounces	500 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	3 pounds	360.0 grams
Kodak Ammonium Chloride . . . . .	6¾ ounces	50.0 grams

When the hypo and ammonium chloride are dissolved completely add stock hardener solution and water as follows:

Kodak Hardener F-5a . . . . .	26 ounces	200.0 cc.
Water to make . . . . .	1 gallon	1.0 liter

**Caution:** With rapid fixing baths, do not prolong the fixing time for fine-grained film or plate emulsions or for *any* paper prints; otherwise the image may have a tendency to bleach, especially at temperatures higher than 68°F (20°C). This caution is particularly important in the case of warm-tone papers.

If corrosion is encountered when using Kodak Rapid Fixing Bath F-7 with stainless steel containers, it can be minimized by substituting 8 ounces of Ammonium Sulfate for the 6¾ ounces of Kodak Ammonium Chloride in the one gallon formula (60 grams per liter for 50 grams). When changed in this way, the formula is known as Kodak Rapid Fixer F-9.

## Kodak Fixing Bath F-10

*For Use after Highly Alkaline Developers*

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	11 ounces	330.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	1/4 ounce	7.5 grams
Kodalk . . . . .	1 ounce	30.0 grams
*Kodak Acetic Acid, 28% . . . . .	2 1/4 fluid oz.	72.0 cc.
Kodak Potassium Alum . . . . .	3/4 ounce	22.5 grams
Water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

Dissolve the chemicals in the order given, taking care that each chemical is dissolved completely before adding the next.

Films or plates should be fixed properly in 10 to 15 minutes in a freshly prepared bath. Wash thoroughly and *wipe each negative carefully* before drying. The bath need not be discarded until the fixing time becomes excessive, that is, over 15 minutes.

## Kodak Fixing Bath F-16

*Chrome Alum: for Films and Plates*

### Solution A

	Avoirdupois	Metric
Kodak Sodium Thiosulfate (Hypo) . . . . .	2 pounds	960.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	2 ounces	60.0 grams
Water to make . . . . .	96 ounces	3.0 liters

### Solution B

	Avoirdupois	Metric
Water . . . . .	32 ounces	1.0 liter
Kodak Potassium Chrome Alum . . . . .	2 ounces	60.0 grams
*Kodak Sulfuric Acid . . . . .	1/4 fluid oz.	8.0 cc.

\***Caution:** Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid: otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

Pour solution B into solution A slowly while stirring A rapidly. This bath, when freshly mixed, is recommended for use in hot weather, but it rapidly loses its hardening properties with or without use, when it should be replaced by a fresh bath. With an old bath there is a tendency for scum to form on the surface of the film. Any such scum should be removed by swabbing with cotton before the film is dried.

## Kodak Fixing Bath F-24

*Non-Hardening: For Special Processes*

	Avoirdupois	Metric
Water, about 125°F. (50°C.) . . . . .	16 ounces	500 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	8 ounces	240.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	145 grains	10.0 grams
Kodak Sodium Bisulfite . . . . .	365 grains	25.0 grams
Cold water to make . . . . .	32 ounces	1.0 liter

Dissolve chemicals in the order given.

This bath may be used for films, plates or paper when no hardening is desired.

For satisfactory use, the temperature of the developer, rinse bath, and wash water should not be higher than 68° F. (20° C.).

# WASHING TEST AND HYPO ELIMINATION

Very small traces of hypo retained in films or prints greatly accelerate the rate of fading of the image. It is extremely difficult to test for small quantities of hypo but the following test (Kodak HT-1a) will indicate when the film or prints may be considered reasonably free from hypo. If prints give a negative reaction by this test it is no guarantee that they may not ultimately fade.

When complete removal of hypo is important, prints should be treated in the Hypo Eliminator HE-1.

## Kodak Hypo Test Solution HT-1a

### For Testing Thoroughness of Washing

	Avoirdupois U. S. Liquid	Metric
Distilled Water . . . . .	6 ounces	180 cc.
Kodak Potassium Permanganate . . . . .	4 grains	0.3 gram
Kodak Sodium Hydroxide (Caustic Soda) . . . . .	8 grains	0.6 gram
Water (distilled) to make . . . . .	8 ounces	250 cc.

**Films or Plates:** Take 8 ounces (250 cc.) of pure water in a clear glass and add  $\frac{1}{4}$  dram (1 cc.) of Kodak HT-1a. Then take an 8 x 10-inch film or equivalent from the wash water and allow the water from it to drip for 30 seconds into the glass of test solution. If a small percentage of hypo is present the violet color will turn orange in about 30 seconds and with a larger concentration the orange color will change to yellow. In either case the film should be returned to the wash water and washed until further tests produce no change in the violet color, which indicates that the hypo content has been reduced to a safe margin, thereby insuring satisfactory permanence under normal keeping conditions.

**Papers:** Take 4 ounces (125 cc.) of pure water in a clear glass and add  $\frac{1}{4}$  dram (1 cc.) of Kodak HT-1a. Pour  $\frac{1}{2}$  ounce (15 cc.) of this diluted solution into a clear 1-ounce glass container. Then take six prints, size 4x5 in. or equivalent, from the wash water and allow the water from them to drip for 30 seconds into the  $\frac{1}{2}$  ounce of the dilute test solution. If a small quantity of hypo is present the violet color will turn orange in about 30 seconds and become colorless in one minute. In either case the prints should be returned to the wash water and washed until further test shows no change in color, which indicates that the hypo content has been reduced to a safe margin, thereby insuring satisfactory permanence under normal keeping conditions.

*Note:* Oxidizable organic matter if present in the water reacts with the permanganate solution and changes its color in the same manner as hypo. The water should therefore be tested as follows:

Prepare two samples of the permanganate test solution using distilled water. Then add a volume of the tap water to one test sample equal to that of the wash water drained with the film or prints into the other sample. If the sample to which tap water has been added remains a violet color this indicates the absence of organic matter and it will be unnecessary to make the test in duplicate. If the color is changed slightly by the tap water, however, the presence of hypo in the film or prints will be shown by the relative color change of the two samples. For example, if the tap water sample turned pink and the wash water sample became yellow it would indicate the presence of hypo, while if both remained the same shade this would indicate the absence of hypo.

## Hypo Eliminator HE-1

### For Professional and Amateur Use

	U. S. Liquid	Metric
Water . . . . .	16 ounces	500 cc.
Hydrogen Peroxide (3% solution) . . . . .	4 ounces	125.0 cc.
Ammonia (3% solution) . . . . .	3 $\frac{1}{4}$ ounces	100.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

**Caution:** Prepare the solution immediately before use and keep in an open container under use. Do not store the mixed solution in a stoppered bottle, or the gas evolved may break the bottle.

**Directions for Use:** Wash the prints for about 30 minutes at 65° to 70° F. (18 to 21° C.) in running water which flows rapidly enough to replace the water in the vessel (tray or tank) completely once every 5 minutes. Then immerse each print about 6 minutes at 68° F. (20° C.) in the Hypo Eliminator HE-1 solution and finally wash about 10 minutes before drying. At lower temperatures, increase the washing times.

**Life of HE-1 Solution:** About fifty 8 x 10-inch prints or their equivalent per gallon (4 liters).

**Test for Hypo:** Process with the batch of prints, an unexposed *white* sheet of photographic paper (same weight and size as majority of prints in batch). After the final wash, cut off a strip of this sheet and immerse it in a 1 per cent silver nitrate solution for about 3 minutes; then rinse in water and compare *while wet* with the *wet untreated portion*. If the hypo has been completely removed, no color difference should be observed. A yellow-brown tint indicates the presence of hypo. The depth of the tint increases with increased hypo content. A positive test with silver nitrate may also be obtained in the absence of hypo if hydrogen sulfide or wood extracts are present in the water supply.

#### Occasional Effects When Using the Peroxide-Ammonia Treatment (HE-1)

1. Slight tendency for prints to stick to belt on belt dryers. To prevent this effect bathe the prints about 3 minutes in a 1 per cent solution of formaldehyde prior to drying.
2. An almost imperceptible change in the image tone. To prevent this effect, add 15 grains of potassium bromide to each quart (1 gram per liter) of the peroxide-ammonia bath (HE-1).
3. A very faint yellowing of the whites (undetectable on buff papers). To minimize this effect, bathe the prints in a 1 per cent sodium sulfite solution for about 2 minutes immediately after treatment in HE-1 and prior to the final wash.

**NOTE:** With *buff papers*, it is possible to use a higher concentration of peroxide (maximum about 500 cc. of 3% solution per liter) and thus extend the exhaustion life to about eighty 8x10-inch prints per gallon. This more concentrated bath is *not* recommended for use with white papers used by professional photographers because the yellowing would be objectionable.

## Kodak Gold Protective Solution GP-1

### For Increasing the Permanency of Silver Images

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	24 ounces	750 cc.
*Kodak Gold Chloride . . . . . (1% stock solution)	2½ drams	10.0 cc.
Kodak Sodium Thiocyanate . . . . .	145 grains	10.0 grams
Water to make . . . . .	32 ounces	1.0 liter

\*A 1% stock solution of Kodak Gold Chloride may be prepared by dissolving the contents of one tube (15 grains) in 3¼ ounces of water (1 gram in 100 cc. of water).

Add the Gold Chloride stock solution to the volume of water indicated. Dissolve the Sodium Thiocyanate *separately* in 4 ounces (125 cc.) of water. Then add the thiocyanate solution slowly to the gold chloride solution while stirring the latter solution rapidly.

**For Use:** Immerse the well washed print (which preferably has received a hypo elimination treatment) in the Gold Protective Solution for 10 minutes at 68° F. (20° C.) or until a just perceptible change in image tone (very slightly bluish black) takes place. Then wash for 10 minutes in running water and dry as usual.

**Approximate Exhaustion Life:** Thirty 8 x 10-inch prints per gallon. For best results the Kodak GP-1 solution should be mixed immediately before use.

**Films and Plates:** The above procedure may also be used with fine-grained images on films and plates when maximum permanency is desired.

# INTENSIFIERS AND REDUCERS

If negatives need intensification or reduction, it is best to give them such treatment immediately after they have been washed. Much time is saved and the negatives, when dry, are ready for finishing.

**Precautions:** Stains are sometimes produced during intensification or reduction unless the following precautions are observed: 1. The negative should be fixed and washed thoroughly before treatment and be free of scum or stain. 2. It should be hardened in the formalin hardener Kodak SH-1 before the intensification or reduction treatment. 3. Only one negative should be handled at a time and it should be agitated thoroughly during the treatment. Following the treatment, the negative should be washed thoroughly and wiped off carefully before drying.

## Intensifiers

The mercury intensifier and the quinone-thiosulfate intensifier are recommended where extreme intensification is desired but where permanence of the resulting image is not essential. If permanence is essential, either the chromium or the silver intensifier should be used.

### Kodak Mercury Intensifier In-1

#### For Films and Plates

BLEACH the negative in the following solution until it is white, *then wash thoroughly.*

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Bromide . . . . .	¾ ounce	22.5 grams
Mercuric Chloride . . . . .	¾ ounce	22.5 grams
Water to make . . . . .	32 ounces	1.0 liter

The negative can be blackened with 10% sulfite solution, a developing solution, such as Kodak D-72 diluted 1 to 2, or 10% ammonia [1 part concentrated ammonia (28%) to 9 parts water], these giving progressively greater density in the order given. To increase contrast greatly, treat with the following solution:

#### Solution A

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	16 ounces	500.0 cc.
*Sodium Cyanide . . . . .	½ ounce	15.0 grams

#### Solution B

Water . . . . .	16 ounces	500 cc.
Kodak Silver Nitrate, crystals . . . . .	¾ ounce	22.5 grams

*\*Warning: Cyanide is a deadly poison and should be handled with extreme care. Use rubber gloves and avoid exposure to its fumes. Cyanide reacts with acid to form poisonous hydrogen cyanide gas. When discarding a solution containing cyanide, always run water to flush it out of the sink quickly. Cyanide solutions should never be used in poorly ventilated rooms.*

To prepare the intensifier, add the silver nitrate, Solution B, to the cyanide, Solution A, until a permanent precipitate is just produced; allow the mixture to stand a short time and filter. This is called Monckhoven's intensifier.

Redevelopment cannot be controlled as with the chromium intensifier, Kodak In-4, but must go to completion.



## Kodak Chromium Intensifier In-4

### For Films and Plates

	Stock Solution	
	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Bichromate . . .	3 ounces	90.0 grams
Hydrochloric Acid (Conc.) . . .	2 fluid oz.	64.0 cc.
Water to make . . .	32 ounces	1.0 liter

NOTE: See precautions on handling negatives given above.

For use, take 1 part of stock solution to 10 parts of water.

Harden the negative first in the Kodak Special Hardener SH-1. Bleach thoroughly at 65° to 70° F (18° to 21° C), then wash five minutes and redevelop fully in artificial light or daylight (not sunlight) in any quick-acting, non-staining developer which does not contain an excess of sulfite: for example, about 10 minutes at 68° F (20° C) in Kodak D-72, diluted 1:3. Then rinse, fix for five minutes, and wash thoroughly. Greater intensification can be secured by repeating the process.

**Warning:** Slow working developers, such as Kodak D-76, Kodak Microdol, and Kodak DK-20, should not be used since they tend to dissolve the bleached image before the developing agents are able to act on it.

Negatives intensified with chromium are more permanent than those intensified with mercury.

The Kodak Chromium Intensifier Powders are equally as satisfactory as Kodak In-4, and are supplied in prepared form ready to use simply by dissolving in water.

## Kodak Silver Intensifier In-5

### For Films and Plates

The following formula is the only intensifier known that will not change the color of the image on positive film on projection. It gives proportional intensification and is easily controlled by varying the time of treatment. The formula is equally suitable for positive and negative film.

#### Stock Solution No. 1 (Store in a brown bottle)

	Avoirdupois U. S. Liquid	Metric
Kodak Silver Nitrate, crystals . . .	2 ounces	60.0 grams
Distilled water to make . . .	32 ounces	1.0 liter

#### Stock Solution No. 2

Kodak Sodium Sulfite, desiccated . . .	2 ounces	60.0 grams
Water to make . . .	32 ounces	1.0 liter

#### Stock Solution No. 3

Kodak Sodium Thiosulfate (Hypo) . . .	3½ ounces	105.0 grams
Water to make . . .	32 ounces	1.0 liter

#### Stock Solution No. 4

Kodak Sodium Sulfite, desiccated . . .	½ ounce	15.0 grams
Elon . . .	350 grains	24.0 grams
Water to make . . .	96 ounces	3.0 liters

NOTE: See precautions on handling negatives given above.

Prepare the intensifier solution for use as follows: Slowly add 1 part of Solution No. 2 to 1 part of Solution No. 1, shaking or stirring to obtain thorough mixing. The white precipitate which appears is then dissolved by the addition of 1 part of Solution No. 3. Allow the resulting solution to stand a few minutes until clear. Then add, with stirring, 3 parts of Solution No. 4. The intensifier is then ready for use and the film should be treated immediately. The mixed intensifier solution is stable for approximately 30 minutes at 68° F (20° C).

The degree of intensification obtained depends upon the time of treatment which

should not exceed 25 minutes. After intensification, immerse the film for 2 minutes with agitation in a plain 30% hypo solution. Then wash thoroughly.

The stability of the mixed intensifier solution and the rate of intensification are very sensitive to changes in the thiosulfate concentration. A more active but less stable working solution may be obtained by using a stock solution No. 3 prepared with 3 ounces of hypo per 32 ounces (90 grams per liter) instead of the quantity in the formula. The directions for preparing the working solution are the same as before but the mixed intensifier will not keep over 20 minutes at 68°F (20°C).

For best results, the intensifier should be used in artificial light; the solution tends to form a precipitate of silver quite rapidly when exposed directly to sunlight.

## Kodak Quinone-Thiosulfate Intensifier In-6

### For Use with Very Weak Negatives

This type of intensifier produces the greatest degree of intensification of any known single solution formula when used with high speed negative materials. The intensified image is of a brownish hue and is not indefinitely permanent, but its permanence under usual conditions of storage is considered analogous to that of uranium-toned images. The intensified image is destroyed by acid hypo so that under no circumstances should the intensified negatives be placed either in fixing baths or in wash water contaminated with fixing bath.

#### Solution A

	Avoirdupois	
	U. S. Liquid	Metric
*Water (about 70°F)	96 ounces	750.0 cc.
**Kodak Sulfuric Acid	4 ounces	30.0 cc.
Kodak Potassium Bichromate	3 ounces	22.5 grams
Water to make	1 gallon	1.0 liter

\*Caution: Always add the sulfuric acid to the water slowly, stirring constantly, and never the water to the acid; otherwise the solution may boil and spatter the acid on the hands or face causing serious burns.

#### Solution B

*Water (about 70°F)	96 ounces	750.0 cc.
Kodak Sodium Bisulfite	½ ounce	3.8 grams
Kodak Hydroquinone	2 ounces	15.0 grams
Kodak Photo-Flo	½ ounce	3.8 grams
Water to make	1 gallon	1.0 liter

#### Solution C

*Water (about 70°F)	96 ounces	750.0 cc.
Kodak Sodium Thiosulfate (Hypo)	3 ounces	22.5 grams
Water to make	1 gallon	1.0 liter

\*The water used for mixing the solutions for the intensifier should not have a chloride content greater than about 15 parts per million (equivalent to about 25 parts of sodium chloride per million), otherwise the intensification will be impaired. If in doubt as to chloride content, use distilled water.

For use: To 1 part of Solution A with stirring add 2 parts of Solution B, then 2 parts of Solution C; continue stirring and finally add 1 part of Solution A. The order of mixing is important and should be followed.

The stock solutions will keep in stoppered bottles for several months and the mixed intensifier is stable for two or three hours without use. The bath should be used only once and then discarded, because a used bath may produce a silvery scum on the surface of the image.

Wash the negatives 5 to 10 minutes, harden in Kodak SH-1 for 5 minutes, and wash again for 5 minutes before intensification.

For highest degree of intensification, treat for about 10 minutes at 68° F (20° C), then wash 10 to 20 minutes and dry as usual; for a lower degree of intensification, treat for shorter times. Agitate frequently to avoid streaking. Treat only one negative at a time when processing in a tray.

## Redevelopment Intensifier

A simple method of intensification for negatives consists of bleaching in the ferricyanide and bromide formula used for the sepia toning of prints (Kodak T-7a) and blackening with sodium sulfide exactly as in print toning.

## Reducers

Reducer formulas may be classified into three types as follows:

A. Subtractive or cutting reducers which remove equal quantities of silver from the high, intermediate, and low densities respectively. They have the effect of clearing up the shadow areas and therefore appear to increase the image contrast but they do not change gamma. They are useful for treating fogged or overexposed images. Kodak R-2 and R-4a are in this group.

B. Proportional reducers which remove density in an amount which is proportional to the original density. They therefore lower gamma and also visual contrast and correct for overdevelopment. Kodak R-4b, R-5, and R-8 are in this group.

C. Super-proportional reducers which remove density increments which bear a greater proportion to the original density as the magnitude of the original density increases. They therefore reduce the highlight densities without destroying shadow detail and are useful for treating overdeveloped negatives of contrasty subjects.

Kodak R-15 is of this type.

### Kodak Reducer R-2

#### Cutting: For Clearing Shadow Areas

##### Stock Solution A

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	32 ounces	1.0 liter
Kodak Potassium Permanganate . . . . .	1¾ ounces	52.5 grams

Completely dissolve the permanganate crystals in a small volume of hot water (about 180° F or 80° C); then dilute to volume with cold water.

##### Stock Solution B

Water . . . . .	32 ounces	1.0 liter
*Kodak Sulfuric Acid . . . . .	1 fluid oz.	32.0 cc.

\***Caution:** Always add the sulfuric acid to the water slowly, stirring constantly, and never the water to the acid; otherwise the solution may boil and spatter the acid on the hands or face causing serious burns.

NOTE: See precautions on handling negatives given above.

For use, take 1 part A, 2 parts B and 64 parts of water. When the negative has been reduced sufficiently place it in a fresh acid fixing bath (Kodak F-5) for a few minutes, to remove yellow stains, then wash thoroughly.

If reduction is too rapid, use a larger volume of water when diluting the solution for use. This solution should *not be used* as a stain remover as it has a tendency to attack the image before it removes the stain. Use Kodak S-6 for removing stains.

NOTE: If a scum forms on the top of the permanganate solution or a reddish curd appears in the solution, it is because the negative has not been sufficiently washed to remove all hypo, or because the permanganate solution has been contaminated by hypo. The separate solutions will keep and work perfectly for a considerable time if proper precautions against contamination are observed. The two solutions should not be combined until immediately before use. They will not keep long in combination.

A close observance of the foregoing instructions is important. Otherwise an iridescent scum will sometimes appear on the reduced negatives after they are dry; and this is difficult, if not impossible, to remove.

### Kodak Farmer's Reducer R-4a

#### Cutting: For Clearing Shadow Areas

##### Stock Solution A

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Ferricyanide . . . . .	1¾ ounces	37.5 grams
Water to make . . . . .	16 ounces	500 cc.

**Stock Solution B**

	Avoirdupois U. S. Liquid	Metric
Kodak Sodium Thiosulfate (Hypo) . . . . .	16 ounces	480.0 grams
Water to make . . . . .	64 ounces	2.0 liters

NOTE: See precautions on handling negatives given above.

For use take: Stock Solution A, 1 ounce (30 cc.), stock solution B, 4 ounces (120 cc.), and water to make 32 ounces (1 liter). Add A to B, then add the water and pour the mixed solution at once over the negative to be reduced, which preferably should be contained in a white tray. Watch closely. When the negative has been reduced sufficiently, wash thoroughly before drying.

For less rapid reducing action, use one-half the above quantity of Stock Solution A, with the same quantities of Stock Solution B and water.

Solutions A and B should not be combined until they are to be used. They will not keep long in combination.

**Kodak Farmer's Reducer R-4b****Proportional: For Lowering Contrast**

Farmer's Reducer also may be used as a two-bath formula to give almost proportional reduction and correct for overdevelopment. The single solution Farmer's Reducer gives only cutting reduction and corrects for overexposure.

**Solution A**

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Ferricyanide . . . . .	1/4 ounce	7.5 grams
Water to make . . . . .	32 ounces	1.0 liter

**Solution B**

Kodak Sodium Thiosulfate (Hypo) . . . . .	6 3/4 ounces	200.0 grams
Water to make . . . . .	32 ounces	1.0 liter

NOTE: See precautions on handling negatives given above.

Treat the negatives in Solution A with uniform agitation for 1 to 4 minutes at 65-70° F (18-21° C) depending on the degree of reduction desired. Then immerse them in Solution B for 5 minutes and wash thoroughly. The process may be repeated if more reduction is desired.

**Kodak Reducer R-5****Proportional: For Lowering Contrast****Stock Solution A**

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	32 ounces	1.0 liter
Kodak Potassium Permanganate . . . . .	4 grains	0.3 gram
*Sulfuric Acid (10% solution) . . . . .	1/2 fluid oz.	16.0 cc.

**Stock Solution B**

Water . . . . .	96 ounces	3.0 liters
Kodak Potassium Persulfate . . . . .	3 ounces	90.0 grams

\*To make a 10% solution of sulfuric acid, take 1 part of Kodak Sulfuric Acid and add it to 9 parts of water, slowly with stirring. *Never add the water to the acid*, because the solution may boil and spatter the acid on the hands or face, causing serious burns.

NOTE: See precautions on handling negatives given above.

For use, take one part of Solution A to three parts of Solution B. When sufficient reduction is secured the negative should be cleared in a 1% solution of sodium bisulfite. Wash the negative thoroughly before drying.

## Kodak Reducer R-8

**Semi-Proportional: For Lowering Contrast and Clearing Shadow Areas**

	Avoirdupois U. S. Liquid	Metric
Water, about 125°F (50°C) . . . . .	24 ounces	750 cc.
Ferric Chloride . . . . .	365 grains	25.0 grams
*Kodak Potassium Citrate . . . . .	2½ ounces	75.0 grams
Kodak Sodium Sulfite, desiccated . . . . .	1 ounce	30.0 grams
Kodak Citric Acid . . . . .	290 grains	20.0 grams
Kodak Sodium Thiosulfate (Hypo) . . . . .	6¾ ounces	200.0 grams
Water to make . . . . .	32 ounces	1.0 liter

\*Sodium citrate should not be used in place of potassium citrate because the rate of reduction is slowed up considerably.

NOTE: See precautions on handling negatives given above.

Dissolve chemicals in the order given.

Use full strength for maximum rate of reduction. Treat negatives 1 to 10 minutes at 65° to 70° F (18° to 21° C). Then wash thoroughly. If a slower action is desired, dilute one part of solution with one part of water. The reducer is especially recommended for the treatment of dense, contrasty negatives.

This is the only single solution reducer which keeps well in a tank.

## Kodak Persulfate Reducer R-15

**Super-Proportional: For Great Reduction of Contrast**

Stock Solution A		
	Avoirdupois U. S. Liquid	Metric
Water . . . . .	32 ounces	1 liter
Potassium Persulfate . . . . .	1 ounce	30 grams
Stock Solution B		
Water . . . . .	8 ounces	250 cc.
*Sulfuric Acid (10% solution) . . . . .	½ ounce	15 cc.
Water to make . . . . .	16 ounces	500 cc.

\*To prepare a 10% solution of sulfuric acid, take 1 part of Kodak Sulfuric Acid and, with caution to avoid contact with the skin, add it slowly to 9 parts of water with stirring. *Never add the water to the acid*, because the solution may boil and spatter the acid on the hands or face causing serious burns.

For use: Take 2 parts of Solution A and add 1 part of Solution B. Only glass, hard rubber, or impervious and unchipped enamelware should be used to contain the reducer solution during mixing and use.

Treat the negative in the Kodak Special Hardener SH-1 for 3 minutes and wash thoroughly before reduction. Immerse in the reducer with frequent agitation and inspection (accurate control by time is not possible) and treat until the required reduction is almost attained; then remove from the solution, immerse in an acid fixing bath for a few minutes, and wash thoroughly before drying. Used solutions do not keep well and should be promptly discarded.

For best keeping in storage, the persulfate stock solution A should be kept away from excessive heat and light. Keeping life of stock solution A—about 2 months at 75°F.

# TRAY CLEANERS—STAIN REMOVERS

## Kodak Tray Cleaner TC-1

### For General Use

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	32 ounces	1.0 liter
Kodak Potassium Bichromate . . . .	3 ounces	90.0 grams
*Kodak Sulfuric Acid . . . . .	3 ounces	96.0 cc.

**\*Caution:** Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

For use, pour a small volume of the tray cleaner solution in the vessel to be cleaned. Rinse around so that the solution has access to all parts of the tray; then pour the solution out and wash the tray six or eight times with water until all traces of the cleaning solution disappear. This solution will remove stains caused by oxidation products of developers and some silver and dye stains. It is a very useful cleaning agent.

## Kodak Tray Cleaner and Hand Stain Remover, TC-3

### Solution A \*

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	1 gallon	1.0 liter
Kodak Potassium Permanganate . . . .	1/4 ounce	2.0 grams
**Kodak Sulfuric Acid . . . . .	1/2 ounce	4.0 cc.

\*Store the solution in a stoppered glass bottle away from the light.

**\*\*Caution:** Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

### Solution B

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	1 gallon	1.0 liter
Kodak Sodium Bisulfite . . . . .	4 ounces	30.0 grams
Kodak Sodium Sulfite, desiccated . . . .	4 ounces	30.0 grams

The Solutions A and B can be used for cleaning several vessels but should be discarded after use.

An acid fixing bath may be used in place of Solution B but it is important to wash thoroughly to eliminate hypo from the tray or hands.

**Cleaning Trays:** To remove stains due to silver, silver sulfide, and many dyes, pour a small quantity of Solution A into the vessel and allow to remain for a few minutes; rinse well and then replace with a similar volume of Solution B. Agitate so as to clear the brown stain completely, then wash thoroughly.

**Cleaning the Hands:** To clean stains from the nails and skin, remove rings from the fingers and immerse the hands for 1 to 3 minutes in solution A contained in a glass or other suitable vessel, gently rubbing the stained areas. Rinse briefly in running water and immerse for a few minutes in Solution B; then wash thoroughly, preferably in warm water.

## Kodak Stain Remover S-6

### For Removal of Developer Stain on Negatives

Developer or oxidation stain may be removed by first hardening the film for 2 or 3 minutes in the formalin hardener (Kodak SH-1) then washing for 5 minutes and bleaching in:

#### Stock Solution A

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Permanganate . . . . .	75 grains	5.2 grams
Water to make . . . . .	32 ounces	1.0 liter

#### Stock Solution B

Cold Water . . . . .	16 ounces	500 cc.
Sodium Chloride . . . . .	2½ ounces	75.0 grams
*Kodak Sulfuric Acid . . . . .	½ ounce	16.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

**\*Caution:** Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

**NOTE:** See precautions on handling negatives given above.

Use equal parts of A and B. The solutions should not be mixed until ready for immediate use since they do not keep long after mixing. All particles of permanganate should be dissolved completely when preparing Solution A, since undissolved particles are likely to produce spots on the negative. Bleaching should be complete in 3 or 4 minutes at 68° F. (20° C.). The brown stain of manganese dioxide formed in the bleach bath is best removed by immersing the negative in 1% sodium bisulfite solution. Then rinse well and develop in strong light, preferably sunlight, with any non-staining developer such as Kodak D-72 diluted 1 part to 2 parts of water. Then wash thoroughly.

**Warning:** Slow working developers, such as Kodak D-76, Kodak Microdol, and Kodak DK-20, should not be used since they tend to dissolve the bleached image before the developing agents are able to act on it.

# TONING FORMULAS

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Three distinct methods of toning are possible:

- (1) Toning by direct development.
- (2) Toning by replacement of the silver image with inorganic salts (metal tones).
- (3) Toning with dyes (dye tones).

## 1. Toning by Direct Development

THE color of the silver image produced by development is determined by the size and condition of the silver particles composing the image. It is possible to control the size of these particles and therefore the color of the image by modifying the nature of the developer.

The range of colors obtainable, however, is not very great and it is usually easier and more certain to produce such slight modifications of color either by delicate dye tinting or by giving a short immersion in one of the diluted toning baths.

## 2. Toning by Replacement of the Silver Image with Inorganic Salts

SINCE most toning processes intensify the original silver image, it is best to commence with a slide or positive print which is somewhat on the thin side. Experience will dictate the most suitable image quality to yield the best results with various toning processes.

### Stability of Solutions:

All toning baths containing potassium ferricyanide are sensitive to light, the ferricyanide being reduced to ferrocyanide, with the resulting formation of a sludge of the metallic ferrocyanide. When not in use, tanks should be covered to prevent exposure to daylight, and small volumes of solution should be placed in dark brown bottles.

It is important that no metallic surface, however small, come in contact with the solution. Glass trays are best, but enameled trays can be used if they are in good condition, with no cracks or chipped spots. Wooden or stoneware tanks with hard rubber faucets should be used for large scale work. Motion-picture film should be wound on wooden racks, free of metal pegs.

## 3. Dye Toning

It is not possible to obtain more than a limited number of tones by the use of colored inorganic compounds owing to the limited number of such compounds. Certain inorganic compounds, however, such as silver ferrocyanide, can be used as mordants for basic dyes such as Victoria Green, Safranin, etc. If, therefore, a silver image is converted more or less to a silver ferrocyanide image and then immersed in a solution of a basic dye, a mordanted dye image is produced.

Immersion of a silver image in an acid solution of potassium ferricyanide will produce a satisfactory mordant image of silver ferrocyanide but, if the image is left too long in the acid ferricyanide bath, the mordanting action of the silver ferrocyanide image is destroyed. By incorporating uranium (uranyl) nitrate in the bath, brown uranyl ferrocyanide is deposited along with the silver ferrocyanide which serves as a signal to indicate when the film should be removed from the mordanting bath. When the black silver image just commences to turn brown, sufficient silver ferrocyanide has been formed to mordant basic dyes strongly but, if the time of immersion is prolonged so that the image is appreciably colored, it will not mordant as well.



## Toning Baths for Slides and Transparencies

### Kodak Uranium Toner T-9

*For Brown to Red Tones on Slides or Films*

	Avoirdupois U. S. Liquid	Metric
Kodak Uranium Nitrate . . . . .	35 grains	2.5 grams
Kodak Potassium Oxalate . . . . .	35 grains	2.5 grams
Kodak Potassium Ferricyanide . . . . .	15 grains	1.0 gram
Ammonium Alum . . . . .	85 grains	6.0 grams
*Hydrochloric Acid, 10% solution . . . . .	1¼ drams	5.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

\*To make a 10% solution, add 1 part of concentrated hydrochloric acid to 9 parts of water, slowly with stirring.

Dissolve chemicals in the order given.

The solution should be perfectly clear and pale yellow in color. *It is light sensitive, however, and should be stored in the dark.*

The maximum toning effect is produced in about 10 minutes, the tone passing from brown to red during this time.

After toning, wash for about 10 minutes; the washing should not be prolonged, especially if the water is slightly alkaline, since the toned image is soluble in alkali.

### Kodak Sulfide Toner T-10

*For Warm Sepia Tones on Lantern Slides*

	Solution A Avoirdupois U. S. Liquid	Metric
Kodak Potassium Ferricyanide . . . . .	1 ounce	30.0 grams
Kodak Potassium Bromide . . . . .	½ ounce	15.0 grams
Water to make . . . . .	32 ounces	1.0 liter

#### Solution B

*Kodak Sodium Sulfide (not sulfite) . . . . .	13 grains	0.9 gram
Water to make . . . . .	32 ounces	1.0 liter

\*Use three times the quantity if crystalline sodium sulfide is used.

The well washed slide, or film, is thoroughly bleached in Solution A, washed for 5 minutes, and immersed in Solution B for about 2 minutes until thoroughly toned. The slide should then be washed thoroughly for 10 to 15 minutes before drying. The transparency of the tone is much improved by the addition of a little hypo to the B solution, say, 66 grains per 32 ounces or 4.5 grams per liter.

### Kodak Iron Toner T-11

*For Blue Tones on Slides or Films*

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Persulfate . . . . .	7 grains	0.5 gram
Kodak Iron and Ammonium Sulfate (Ferric Alum) . . . . .	20 grains	1.4 grams
Kodak Oxalic Acid . . . . .	45 grains	3.0 grams
Kodak Potassium Ferricyanide . . . . .	15 grains	1.0 gram
Ammonium Alum . . . . .	73 grains	5.0 grams
*Hydrochloric Acid, 10% solution . . . . .	¼ dram	1.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

\*To make a 10% solution, add 1 part of concentrated hydrochloric acid to 9 parts of water, slowly with stirring.

Dissolve chemicals in the order given.

The method of compounding this bath is important. Each of the solid chemicals

should be dissolved separately in a small volume of water; the solutions then should be mixed strictly in the order given, and the whole diluted to the required volume. If these instructions are followed, the bath will be pale yellow in color and perfectly clear.

Immerse the slides or films from 2 to 10 minutes at 68° F. (20° C.) until the desired tone is obtained. Wash for 10 to 15 minutes until the highlights are clear. A slight permanent yellow coloration of the clear gelatin will usually occur, but should be too slight to be detectable on projection. If the highlights are stained blue, then either the slide (film) was fogged during development, or the toning bath was stale or not mixed correctly.

Since the toned image is soluble in alkali, washing should not be carried out for too long a period, especially if the water is slightly alkaline.

## Mixed Iron and Uranium Tones

By mixing the uranium (Kodak T-9) and iron (Kodak T-11) toning solutions in different proportions, tones ranging from reddish-brown to chocolate are produced. Analogous results may be obtained by immersing the film or slide in each solution successively for varying times.

### Kodak Mordant Bath T-17

#### For Dye Toning

##### Stock Solution

	Avoirdupois	Metric
Kodak Uranium Nitrate . . . . .	116 grains	8.0 grams
Kodak Oxalic Acid, . . . . .	58 grains	4.0 grams
Kodak Potassium Ferricyanide . . . . .	58 grains	4.0 grams
Water to make . . . . .	32 ounces	1.0 liter

**Directions for Mixing:** First dissolve each chemical separately in a small volume of water. Then add the oxalic acid solution to the uranyl nitrate solution and finally add the ferricyanide solution. If the uranyl nitrate is added directly to the potassium ferricyanide, a brown precipitate will be obtained which will not dissolve readily in the oxalic acid. After mixing, the bath should be light yellow and perfectly clear. The solution should not be exposed to light any more than necessary.

For use, take 1 part of stock solution and 4 parts water.

**Time of Mordanting:** Immerse the film (slide) at 65° to 70° F. (18° to 21° C.) until a very slight chocolate colored tone is obtained; then remove film at once. If mordanting is prolonged much beyond this point, inferior tones will be produced. With a new bath this will require from 1½ to 2 minutes, but the time will need to be increased as the bath ages. The solution may be revived at intervals by adding a little of the concentrated stock solution.

**Time of Washing after Mordanting:** Wash until the highlights are free from yellow stain; this usually takes about 10 to 15 minutes. Do not prolong the washing for more than 20 minutes or some of the mordant will be washed out.

## Kodak Dye Bath T-17a

### For Use with Slides or Films after the Kodak Mordant Bath T-17

	Avoirdupois U. S. Liquid	Metric
Dye . . . . .	3 grains	0.2 gram
*Kodak Acetic Acid, 10% . . . . .	1¼ drams	5.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

\*To make approximately 10% acetic acid, take 1 part glacial acetic acid (or 5 parts 28% acetic acid) and add it slowly to 9 parts of water.

Thoroughly dissolve the dye in hot water, filter, add the acid, and dilute to volume with cold water.

The following dyes are suitable for toning:

Safranine A	Red
Chrysoidine 3R	Orange
Auramine	Yellow
Victoria Green	Green
Methylene Blue BB	Blue
*Methyl Violet	Violet

\*For methyl violet use one-quarter the quantity of dye given in the formula.

**Time for Dye Toning:** Immerse the mordanted and washed film (slide) in the dye bath for 2 to 15 minutes at 65° to 70° F (18° to 21° C) according to the color desired. The quantity of dye which mordants to the image increases with time. In case an image is over-dyed, some of the dye may be removed by immersing in a 0.2% solution of ammonia; then rinse before drying.

If, after dyeing 10 minutes, the image does not mordant sufficient dye, remove the film (slide), wash thoroughly, immerse again in the mordanting bath, wash, and re-dye.

**Intermediate Dye Tones:** Intermediate colors may be obtained either by mixing the dye solutions or by immersing the film (slide) in successive baths. For example, if a reddish-orange tone is desired, first tone for a short time in the Safranine bath and then in the Chrysoidine bath, or the two baths may be mixed in suitable proportions and the tone secured with a single treatment.

## Kodak Toner T-18

### For Double Tones on Slides or Films

**Double Tones:** This bath tones the halftones white and the shadows blue. If the resulting image is immersed in any of the basic dye solutions, which are used for dye toning (Kodak T-17a), the dye is mordanted to the halftones while the shadows remain more or less blue. By varying the dye solution used, the color of the halftones may be varied at will.

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Persulfate . . . . .	7 grains	0.5 gram
Kodak Iron and Ammonium Sulfate (Ferric Alum) . . . . .	20 grains	1.4 grams
Kodak Oxalic Acid . . . . .	45 grains	3.0 grams
Kodak Potassium Ferricyanide . . . . .	15 grains	1.0 gram
*Hydrochloric Acid, 10% . . . . .	¼ dram	1.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

\*To make a 10% solution, add 1 part of concentrated hydrochloric acid to 9 parts of water, slowly with stirring.

The instructions for preparing the bath are the same as for the Iron toning bath (Kodak T-11).

**Directions for Use:** Tone until the shadows are deep blue. Then wash 10 to 15 minutes. Immerse in the basic dye solution used for dye toning for 5 to 15 minutes until the desired depth of color in the halftones is obtained. Wash 5 to 10 minutes after dyeing until the highlights are clear.

# Kodak Single Solution Dye Toner T-20

## For Slides or Films

	Avoirdupois U. S. Liquid	Metric
*Dye . . . . .	x grains	x grams
Kodak Wood Alcohol (or Acetone) . . . . .	3¼ fluid oz.	100.0 cc.
Kodak Potassium Ferricyanide . . . . .	15 grains	1.0 gram
**Kodak Acetic Acid, 28% . . . . .	4½ drams	18.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

\*The quantity of dye varies according to the dye used as follows:

\*\*To make approximately 28% acetic acid from glacial acetic, dilute 3 parts of glacial acetic acid with 8 parts of water.

Safranine Extra Bluish . . . . .	3 grains	0.2 gram
Chrysoidine 3R . . . . .	3 grains	0.2 gram
Auramine . . . . .	6 grains	0.4 gram
Victoria Green . . . . .	6 grains	0.4 gram
Rhodamine B . . . . .	6 grains	0.4 gram

The nature of the tone varies with time of toning and eventually a point is reached beyond which it is unsafe to continue as the gradation of the toned image becomes affected. Average toning time at 68° F (20° C) is from 3 to 9 minutes. Further details on the use of this formula may be obtained by referring to the paper by Crabtree and Ives.†

## Tinting Slides or Films

TINTING consists of immersing a film or slide in a solution of an acid dye which colors the gelatin layer, causing the whole picture to have a veil of color over it. Motion picture positive films may be purchased in a wide variety of tinted bases which obviate the necessity for actual coloring.

Sheets of water colors or liquid water colors recommended for coloring photographs may be used for tinting slides or film transparencies. In the case of most colors the absorption of the color is hastened by the addition of 1 volume of glacial acetic acid to 1000 volumes of the dye solution. Bathing for 3 to 4 minutes in the acid dye solution is usually ample. After tinting, the slide should be rinsed in water for a few seconds and wiped off with a moist tuft of absorbent cotton. If the color is too strong, it should be washed in water or a 2 per cent solution of ammonia.

Pleasing effects may also be secured by combined tinting and toning such as a blue tone followed by an orange, red, or yellow tint. The clear portions or highlights thus assume the color of the tinting solution while the halftones and shadows show a color intermediate between the tint and tone used.

Slides fixed in plain or acid hypo (Kodak F-24) take colors better than those fixed in an acid hardening fixing bath.

†"Dye Toning With Single Solutions" by J. I. Crabtree and C. E. Ives, Trans. Soc. Mot. Pict. Eng. No. 36: 967 (1928).

## Toning Baths for Papers

While most of the toning processes are quite simple, the final tone obtained is affected by a number of factors. Successful production of the desired tone depends upon the proper control of every step from the exposure of the sensitive paper to the final drying of the toned print. Therefore, it should be emphasized that uniform quality of black-and-white prints is a prerequisite to consistent success in toning.

A shade of brown is suitable for many subjects. There are three principal methods of producing pleasing sepia tones. These are: (1) production of brown silver sulfide by direct combination of silver and sulfur with the Kodak Hypo-Alum Sepia Toner T-1a or the Kodak Polysulfide Toner T-8; (2) production of silver sulfide indirectly by oxidation of the silver to silver bromide which is then converted to silver sulfide with the Kodak Sulfide Sepia Toner T-7a; and (3) deposition of gold on the silver image, with the Kodak Gold Toner T-21. The different chemical actions of these three processes provide for the treatment of all brands of photographic papers.

### Kodak Hypo Alum Sepia Toner T-1a

	Avoirdupois	Metric
Cold water . . . . .	90 ounces	2800 cc.
Kodak Sodium Thiosulfate (Hypo) . . . . .	16 ounces	480.0 grams

Dissolve thoroughly, and add the following solution:

Hot water, about 160°F. (70°C.) . . . . .	20 ounces	640 cc.
Kodak Potassium Alum . . . . .	4 ounces	120.0 grams

Then add the following solution (including precipitate) *slowly to the hypo-alum solution while stirring the latter rapidly.*

Cold water . . . . .	2 ounces	64.0 cc.
Kodak Silver Nitrate, crystals . . . . .	60 grains	4.2 grams
Sodium Chloride . . . . .	60 grains	4.2 grams

After combining above solutions.

Add water to make . . . . .	1 gallon	4.0 liters
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*Note:* The silver nitrate should be dissolved completely before adding the sodium chloride and immediately afterward, the solution containing the milky white precipitate should be added to the hypo-alum solution as directed above. The formation of a black precipitate in no way impairs the toning action of the bath if proper manipulation technique is used.

For use, pour into a tray supported in a water bath and heat to 120° F. (49°C.). At this temperature prints will tone in 12 to 15 minutes depending on the type of paper. Never use the solution at a temperature above 120° F. (49°C.). Blisters and stains may result. Toning should not be continued longer than 20 minutes at 120° F. (49° C.).

In order to produce good sepia tones, the prints should be exposed so that the print is slightly darker than normal when developed normally (1½ to 2 minutes).

The prints to be toned should be fixed thoroughly and washed for a few minutes before being placed in the toning bath. Dry prints should be soaked thoroughly in water. To insure even toning, the prints should be immersed completely, and separated occasionally, especially during the first few minutes.

After prints are toned, they should be wiped with a soft sponge and warm water to remove any sediment, and washed for one hour in running water.

The bath is particularly suitable for use with papers having slightly warm tones, such as Azo, in which the images are composed of comparatively fine grains. Vitava Opal and Vitava Projection also tone well in Kodak T-1a. It is not satisfactory for use with warm tone papers such as Professional Azo.

## Kodak Sulfide Sepia Toner T-7a

### Stock Bleaching Solution A

	Avoirdupois U. S. Liquid	Metric
Kodak Potassium Ferricyanide . . . . .	2½ ounces	75.0 grams
Kodak Potassium Bromide . . . . .	2½ ounces	75.0 grams
Kodak Potassium Oxalate . . . . .	6½ ounces	195.0 grams
*Kodak Acetic Acid, 28% . . . . .	1¼ ounces	40.0 cc.
Water . . . . .	64 ounces	2.0 liters

\*To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

### Stock Toning Solution B

Kodak Sodium Sulfide, (not Sulfite) . . . . .	1½ ounces	45.0 grams
Water . . . . .	16 ounces	500.0 cc.

Prepare Bleaching Bath as follows:

Stock Solution A . . . . .	16 ounces	500 cc.
Water . . . . .	16 ounces	500 cc.

Prepare Toner as follows:

Stock Solution B . . . . .	4 ounces	125 cc.
Water to make . . . . .	32 ounces	1.0 liter

The print to be toned should first be washed thoroughly. Place it in the Bleaching Bath, and allow it to remain until only faint traces of the halftones are left and the black of the shadows has disappeared. This operation will take about one minute.

NOTE: Particular care should be taken *not* to use trays with any *iron* exposed, otherwise blue spots may result.

Rinse *thoroughly* in clean cold water.

Place in Toner Solution until original detail returns. This will require about 30 seconds. Give the print an immediate and thorough water rinse; then immerse it for five minutes in a hardening bath composed of 1 part of the stock hardener Kodak F-1a and 16 parts of water. The color and gradation of the finished print will not be affected by the use of this hardening bath. Remove the print from the hardener bath and wash for one-half hour in running water.

This toning bath tends to give warm tones, an advantage with papers such as Velox, Kodabromide, and Royal Bromide. With the inherently warm-tone papers, such as Azo, Professional Azo, Vitava Opal, Vitava Projection, and Kodalure, it tends to produce rather disagreeable yellow tones.

## Kodak Polysulfide Toner T-8

The following single-solution toning bath is recommended for use on all Kodak papers except Kodalure, Kodabromide, and Royal Bromide. It produces slightly darker sepia tones than the redevelopment-sulfide toner, Kodak T-7a, and has the advantage, compared with hypo alum toners, that it will tone in a much shorter time and does not require heating although raising the temperature to 100° F. reduces the time of toning from 15 to 3 minutes.

	Avoirdupois U. S. Liquid	Metric
Water . . . . .	96 ounces	750 cc.
Polysulfide (Liver of sulfur) . . . . .	1 ounce	7.5 grams
Kodak Sodium Carbonate, desiccated . . . . .	116 grains	2.0 grams
Water to make . . . . .	1 gallon	1.0 liter

Dissolve chemicals in the order given.

Immerse the well washed black-and-white print for 15 to 20 minutes and agitate in the Kodak T-8 bath at 68° F. (20° C.) or for 3 or 4 minutes at 100° F. (38° C.).

Approximate life of toning bath is about 150 8 x 10-inch prints (or equivalent) per gallon. When the bath begins to be cloudy, the life can be extended by the addition of the same quantity of carbonate as in the formula.

After toning, if any sediment appears on the print, the surface should be wiped with a soft sponge and the print then washed for at least 30 minutes before drying.

## Kodak Gold Toner T-21

THE Kodak Gold Toner T-21 has the advantage that a variety of excellent brown tones may be obtained by varying the time of toning, that is, the prints may be removed at any time from the bath when the desired color is reached. It is particularly recommended for use with warm tone papers such as Professional Azo, Vitava Opal, and Kodalure.

### Stock Solution A

	Avoirdupois U. S. Liquid	Metric
Warm water, about 125°F. (50°C.) . . .	1 gallon	4.0 liters
Kodak Sodium Thiosulfate (Hypo) . . .	2 pounds	960.0 grams
Kodak Potassium Persulfate . . . . .	4 ounces	120.0 grams

Dissolve the hypo completely before adding the ammonium persulfate. Stir the bath vigorously while adding the ammonium persulfate. If the bath does not turn milky, increase the temperature until it does.

Prepare the following solution and add it (including precipitate) slowly to the hypo-persulfate solution while stirring the latter rapidly. *The bath must be cool when these solutions are added together.*

Cold water . . . . .	2 ounces	64.0 cc.
Kodak Silver Nitrate, crystals . . . .	75 grains	5.2 grams
Sodium Chloride . . . . .	75 grains	5.2 grams

*Note:* The silver nitrate should be dissolved completely before adding the sodium chloride.

### Stock Solution B

Water . . . . .	8 ounces	250.0 cc.
Kodak Gold Chloride . . . . .	15 grains	1.0 gram

For use, add 4 ounces (125 cc.) of Solution B slowly to Solution A while stirring the latter rapidly.

The bath should not be used until after it has become cold and has formed a sediment. Then pour off the clear liquid for use.

Pour the clear solution into a tray supported in a water bath and heat to 110° F (43° C). During toning the temperature should be between 100° and 110° F (38° and 43° C).

Prints to be toned should be washed for a few minutes after fixing before they are placed in the toning solution. Dry prints should be soaked thoroughly in water before toning.

Keep at hand an untoned black-and-white print for comparison during toning. Prints should be separated at all times to insure even toning.

When the desired tone is obtained (5 to 20 minutes), remove and rinse the prints in cold water. After all prints have been toned, return them to the fixing bath for five minutes, then wash for one hour in running water.

The bath should be revived at intervals by the addition of Gold Solution B. The quantity to be added will depend upon the number of prints toned and the time of toning. For example, when toning to a warm brown, add 1 dram (4 cc.) of gold solution after each fifty, 8 x 10-inch prints or their equivalent have been toned. Fresh solution may be added from time to time to keep the bath up to the proper volume.

## Uranium, Iron, and Dye Tones on Prints

TONES on paper may be obtained with uranium (Kodak T-17) ranging from chocolate to brick red. This formula may also be used as a mordant bath for dye tones. The paper stock usually becomes tinted unless it is protected by squeegeeing temporarily to another support coated with rubber cement. Blue tones may be obtained with an iron toning bath (Kodak T-12).

Toned images obtained with these formulas are not absolutely permanent since they consist of a mixture of silver with one or more of the following compounds: silver ferrocyanide, dye, ferric ferrocyanide, and uranyl ferrocyanide. On exposure to the atmosphere, which usually contains traces of hydrogen sulfide, the silver and uranyl ferrocyanides are converted to silver or uranyl sulfide which is usually apparent as a metallic sheen on the surface of the toned print. This sulfiding of the image can be prevented almost completely by treating the prints with Kodak Print Lacquer.

In all these processes, the final tone depends not only on the time of toning but also on the density of the original print.

**IMPORTANT:** Prints to be toned by any of the following methods should be washed thoroughly, and treated in the Hypo Eliminator HE-1, to insure freedom from hypo. If hypo is present, inferior tones will result.

### Kodak Iron Toner T-12

#### For Blue Tones on Kodabromide, Velox, and Azo Papers

	Avoirdupois	Metric
Kodak Ferric Ammonium Citrate (green scales) . . . . .	58 grains	4.0 grams
Kodak Oxalic Acid, crystals . . . . .	58 grains	4.0 grams
Kodak Potassium Ferricyanide . . . . .	58 grains	4.0 grams
Water to make . . . . .	32 ounces	1.0 liter

Dissolve each chemical separately in a small volume of water, about 8 ounces (250 cc.) and filter before mixing together. This solution does not keep well except in brown bottles.

Immerse the well-washed print in the toning bath for 10 to 15 minutes until the desired tone is obtained. Then wash until the highlights are clear.

### Kodak Mordant Bath T-17

#### For Dye Toning

	Stock Solution	Avoirdupois	Metric
Kodak Uranium Nitrate . . . . .	116 grains	8.0 grams	
Kodak Oxalic Acid, crystals . . . . .	58 grains	4.0 grams	
Kodak Potassium Ferricyanide . . . . .	58 grains	4.0 grams	
Water to make . . . . .	32 ounces	1.0 liter	

Dissolve the uranium nitrate in a small volume of water, about 8 ounces (250 cc.) (about 125° F.) (50° C.). Dissolve the oxalic acid separately in about 8 ounces (250 cc.) of water and filter; then add the oxalic acid solution to the uranium nitrate solution. Dissolve the potassium ferricyanide separately in about 8 ounces (250 cc.) of water; if the solution is clear, add it to the uranium nitrate and oxalic acid solution. If not clear, filter before mixing together.

**For Use as a Toning Bath** (Chocolate to Brick Red). Dilute 1 part of the stock solution with 2 parts of water. As the toning time is increased, the tone changes



from chocolate to brown and finally to brick red. The print may be removed at any stage.

Wash until the highlights are clean; this usually requires from 10 to 15 minutes. Prolonged washing should be avoided.

**For Use as a Mordant for Dye Toning.** Dilute 1 part stock solution with 4 parts of water.

Treat the well-washed print about 2 minutes until the image turns a light chocolate color. Rinse for about 1 minute or less in running water to remove the yellow stain from the highlights. Then immerse for 10 to 15 minutes in the Kodak Dye Bath T-17b.

## Kodak Dye Bath for Papers T-17b

*For Use with Papers after the Kodak Mordant Bath T-17*

	U. S. Liquid	Metric
Dye (1:1000 solution) . . . . .	x fluid oz.	x cc.
*Kodak Acetic Acid, 1% Solution . . . . .	6¾ fluid drams	25.0 cc.
Water to make . . . . .	32 ounces	1.0 liter

\*To make 1% acetic acid, add 1 part 28% acetic acid to 27 parts of water.

x = Volumes of 1:1000 †Dye Solution for Various Colors as Follows:

		U. S. Liquid	Metric
Tone No. 1 Red	Safranine A	¾ ounces	100 cc.
Tone No. 2 Yellow	Auramine	¾ ounces	100 cc.
Tone No. 3 Orange		Use equal parts of Nos. 1 and 2; then add ¾ fluid ounces (100 cc.) of the mixed dye solution when preparing the acid dye bath.	
Tone No. 4 Blue-Green	Victoria Green	¾ ounces	100 cc.
Tone No. 5 Brilliant Green		Use equal parts of Nos. 2 and 4; then add ¾ fluid ounces (100 cc.) of the mixed dye solution when preparing the acid dye bath.	
Tone No. 6 Blue	Methylene Blue BB	¾ ounces	100 cc.
Tone No. 7 Violet	Methyl Violet	½ drams	20 cc.

Mixtures of the following may also be used.

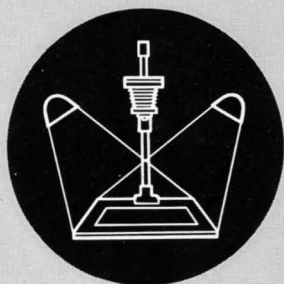
Victoria Green plus Methyl Violet  
 Victoria Green plus Methylene Blue  
 Methyl Violet plus Auramine  
 Methyl Violet plus Victoria Green

The dye toned print should be washed in running water until all extraneous color is removed from the highlights, but prolonged washing should be avoided.

†The 1 to 1000 stock solution of the dye is prepared by dissolving one part of dye in 1000 parts water (1 gram in 1 liter, or 15 grains in 32 ounces).

# COPYING





# COPYING

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Second 1946 Printing



Films, Plates  
and Papers  
for Copying

Equipment for  
Copying

Microfilming  
Equipment

Camera  
Alignment

Lamps for  
Copying

Obtaining  
Correct Exposure

Continuous-Tone  
Originals

Line Originals

Kodak Fine  
Line Process

Copying With  
Kodachrome Film

Micro-File

Contrast  
Process Ortho

Contrast  
Process Pan

Commercial

Commercial  
Matte

Commercial  
Ortho

Panatomic-X

Reflex Copy  
Papers

DATA SHEETS

# COPYING

PHOTOGRAPHERS are finding that a knowledge of copying technique is valuable in their work. Copying by photography provides accurate reproductions of photographic prints, drawings, sketches, daguerreotypes, manuscripts, typed and printed matter, and many similar subjects. Therefore, a knowledge of copying technique extends the art and proficiency of the amateur and in many cases increases the business of the professional.

Elaborate apparatus is not necessary; the photographer will probably find that his equipment is suitable or can be adapted to this type of work. A variety of Kodak cameras, enlargers, and accessories are available for copying, and they are described here.

To meet the specialized requirements of the diverse subject matter and copying methods, the Eastman Kodak Company manufactures over twenty different sensitized products. With the uniformity and ease of manipulation of Kodak materials, the photographer can easily produce copies of good quality, once his technique has been established.

In the following pages, each phase of the general preparatory work for copying, such as placement and lighting of the original, camera alignment, and exposure determination, is discussed fully. The various types of originals most frequently encountered are considered and the most suitable negative materials recommended, and any special requirements in handling or in preparation are mentioned. The use of Kodachrome Film to copy colored originals and the use of ultraviolet and infrared illumination to photograph questioned or illegible documents

are also dealt with. Data Sheets for the most widely used Kodak copying materials follow the text; these include sensitometric curves, filter factors, development recommendations, and other information.

Within recent years a new technique of a specialized nature known as "microfilming" has been developed for making greatly reduced copies of documents, records, newspapers, and similar originals. The copies are made on narrow film, usually 35 mm. or 16 mm. wide, and are read by projecting enlarged images onto a screen or by making enlarged prints. Among the advantages of micro-copies are the saving in space required for storage, the low cost involved, and the convenience in handling. The general copying techniques described here apply both to copying with larger cameras and to microfilming.

Two other specialized copying processes are also described in this book—reflex copying and the new Kodak Fine Line Process. The former requires no camera but is a contact process for which Kodak Reflex Copy Papers are provided. The latter offers a means of retaining fine and coarse lines in the copying of maps and similar originals. A positive mask and special exposing technique are involved.

## EXPLANATION OF COPYING TERMS

Copying terms as they are used in this book are defined here.

**To Copy:** To reproduce photographically (usually in a camera) subjects such as photographs, drawings, book pages, or paintings.

**The Original:** The material to be copied.

**Line Original:** Material such as line drawings or printed matter. In these cases there are only two tones, a dark one and a light one.

**Continuous-Tone Original:** Material which contains many shades of gray or color between the lightest and darkest tones. Photographs and paintings are examples.

**Halftone Original:** A photomechanical reproduction of a continuous-tone original. Such a reproduction is made up of dots.

**The Reproduction:** The photograph obtained by copying. Also called the "copy." (The term "copy" is used by photomechanical workers to designate the material to be copied.)

**Monochrome:** Single color. In a monochrome print, such as a photographic print—either black-and-white or sepia—the various tones are represented by different shades of one color.

**Reflex Copying:** A means of copying black-and-white originals, line or coarse halftone, by contact, exposing through the sensitized paper.

## **Films, Plates, and Papers for Copying**

The photographic and physical properties of the following materials render them especially suited to copying.

### **Kodak Sheet Films**

*Kodachrome Professional Film* provides full-color transparencies from colored originals. It is processed only in Kodachrome Processing Stations, which are listed in the instructions packed with the film.

*Kodak Contrast Process Panchromatic Film* produces extremely high contrast and can be used with filters for copying colored line originals such as blueprints, discolored documents, and other line subjects in colored inks or on colored paper.

*Kodak Contrast Process Ortho Film* produces extremely high contrast and can be used for copying some types of colored originals; yellow filters can be used with it. Development can be carried out by inspection under a suitable red safelight.

*Kodak Commercial Film* is suitable for copying black-and-white continuous-tone originals, such as photographs. *Kodak Commercial Matte Film* is similar to Commercial, but has a matte emulsion and a matte back to permit pencil retouching on either or both sides without retouching varnish. *Kodak Commercial Ortho Film* is recommended for copying many types of colored, continuous-tone originals, for photographing light-colored furniture, and for other commercial work which does not require a red-sensitive film.

*Kodak Panatomic-X Film* is a very fine-grained panchromatic film of moderate speed and contrast, and is excellent for copying black-and-white and colored continuous-tone originals.

*Kodak Infrared Film* has moderate contrast and serves in examining overprinted or charred documents, altered paintings, etc.

### **Kodak Plates**

*Kodak Process Panchromatic Plate* is a high-contrast plate suited to copying black-and-white or colored line originals.

*Kodak Process Plate* provides extreme contrast for copying black-and-white line originals. This plate is blue-sensitive and rather slow.

*Kodak Panchromatic* and *Panchromatic Matte Plates* have moderate contrast and are well adapted to copying colored continuous-tone originals.

*Kodak 33 Plate* gives considerable contrast and is recommended for copying black-and-white continuous-tone originals.

*Kodak 33 Matte Plate* includes a matte surface for retouching.

*Kodak Infrared-Sensitive Plate* resembles Infrared Film in use.

## **Kodak Roll Films and Film Packs**

*Kodak Plus-X Roll Film and Film Packs* with the recommended normal development are suited to copying continuous-tone originals, both colored and black-and-white. Fair negatives of line originals can be made by full development of this film in Kodak DK-60a.

*Kodak Infrared Roll Film* has moderate contrast and can be used for the examination of documents and paintings in the same manner as Infrared Sheet Film and Plates.

## **Kodak 35-mm. Films**

*Kodachrome Film*, for 35-mm. and Kodak Bantam Cameras, provides full-color transparencies upon exposure in a suitable camera and processing in a Kodachrome Processing Station. In the United States, all processed K135 and K828 Kodachrome Films, when exposed in standard cameras, are returned mounted as Kodaslide, ready for projection, unless the customer gives other instructions. Kodachrome transparencies are entirely free from color-screen patterns and are thus ideal for projection. They can also be duplicated or used to obtain Kodak Minicolor Prints.

*Kodak Micro-File Film* is a high-contrast panchromatic film especially suited to line copy work—colored or black-and-white. It has the finest grain and highest resolving power of all the Kodak Films for 35-mm. cameras and is therefore suitable for copying originals having very fine detail.

*Kodak Direct Positive Panchromatic Film* yields excellent positive transparencies on the material exposed in the camera. The reversal processing is easily done by the photographer. In copying work it is particularly suited to making slides from various illustrations.

*Kodak Positive Safety Film* is non-color-sensitive and is suited to continuous-tone black-and-white copying. It can also be used for line work.

*Kodak High Contrast Positive Safety Film* is non-color-sensitive and is especially suited to black-and-white line copy work.

*Kodak Infrared Film* resembles the other infrared materials listed here and is available for 35-mm. and Bantam cameras.

## **Kodak Reflex Copy Paper A and XA**

These are thin-base, high-contrast, orthochromatic materials intended for making contact copies of printed pages, documents, charts, line drawings, coarse-screen halftone illustrations, music, etc., by the *reflex method*. Prints on Reflex Copy Paper A and XA can be folded for mailing.



## Equipment For Copying

### CAMERAS AND LENSES

Many cameras and associated equipment can be used for copying, and the choice depends on the quantity and class of work, type of copy desired, etc. When the photographer does a large quantity of work, a copying outfit with special camera and automatic controls may be necessary. The photographer who wishes to do occasional copying

CAMERAS ADAPTABLE FOR COPYING		
<i>Name of Camera</i>	<i>Negative Size</i>	<i>Negative Material Used</i>
Crown Enlarging, Reducing, and Copying Camera	3¼ x 4¼ to 8 x 10 in. incl.	Sheet film, plates, and paper
Eastman View Cameras Century Universal Cameras Crown View Cameras	4 x 5 to 11 x 14 in.	Sheet film and plates
Kodak Precision Enlargers with Camera Back Adapter A (for 2¼ x 3¼ Kodak Holders) with Camera Back Adapter A (for 2¼ x 3¼ Graflex Holders) with Camera Back Adapter B	2¼ x 3¼ in. 2¼ x 3¼ in. 3¼ x 4¼ in.	Sheet film, film packs, and plates
with Bantam Kodachrome Adapter with 35-mm. Kodachrome Adapter	1 ⅜ x 1 ⅞ in. 1 ⅛ x 1 ⅜ in.	
Kodak Precision Enlarger A with Lantern Slide Adapter	Approx. 1½ x 1½ in.	2 x 2-in. Lantern Slide Plates
Kodak Medalist	2¼ x 3¼ in.	All roll films, sheet films, film packs, plates
Kodak Ektra	1 ⅝ x 1 ⅜ in. (24 x 36-mm.)	All 135 Films
Kodak 35's	1 ⅝ x 1 ⅜ in. (24 x 36-mm.)	All 135 Films
Kodak Bantams	1 ⅜ x 1 ⅞ in. (28 x 40-mm.)	All 828 Films
<b>For cameras with interchangeable lenses the following lenses are recommended for precise copying:</b>		
<i>Lens</i>	<i>Negative Size</i>	
Kodak Ektars f/6.3, 8½, 10, 12, 14-inch	5 x 7 to 8 x 10	
Kodak Anastigmat f/7.7, 8-inch	5 x 7 and 4 x 5	
Kodak Anastigmat f/4.5, 5½-inch	3¼ x 4¼	
Kodak Ektar f/4.7, * 5-inch	3¼ x 4¼	
Kodak Ektar f/4.5, * 4-inch	2¼ x 3¼	
*Also supplied for Kodak Precision Enlarger in metal lens boards.		

can do work of creditable quality with the equipment he has on hand.

The cameras and enlargers listed in the table on the opposite page are readily adaptable for this work.

### Specialized Equipment

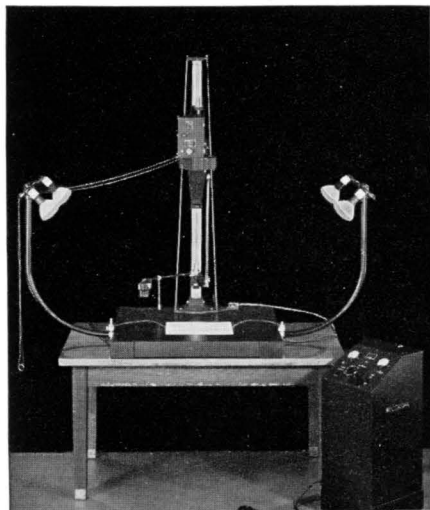
When a large amount of work of a similar specialized nature is done, appropriate copying equipment is advisable. Photostat copying is well known as a convenient means of producing facsimiles of many types of originals. Details are available from the Photostat Corporation, Rochester 4, N. Y. Another specialized copying method is microfilming. By this technique newspapers, deeds, records, and statements are photographed "down" to a greatly reduced size on film. Enormous quantities of reading matter can in this way be stored in a small space.

**The Micro-File Recordaks** are complete units for microfilming. They embody camera, lights, holders for originals, and even built-in photoelectric exposure meters. The Micro-File Recordak, Model D, shown below, is a general-purpose microfilming outfit for medium sized flat documents and bound volumes. It uses Recordak Micro-File Panchromatic Safety Film, in 100-foot 35mm perforated or unperforated rolls, and can be adapted to take 16mm film. The film unit is equipped with a highly corrected Kodak Micro-File Ektar lens, 63mm.

Reduction ratios of from 10 to 20 diameters may be obtained, and focusing is automatic. Pressing a button projects an illuminated image of the film aperture directly on the subject. The area photographed is shown directly by the projected aperture; the aperture size is variable, and making this adjustment also controls the length of film used for the

picture. This results in the most economical use of film. Recordak Film Readers provide the means for quickly scanning microfilm records, 35mm or 16-mm, perforated or unperforated, to find a particular image. The image is then viewed on a brilliant translucent screen at any one of a wide range of magnifications, to

**The Micro-File Recordak, Model D.**



suit the subject matter and the requirements of the user. Photographic enlargements from any frame are made easily with a special paper holder supplied as an accessory with the Model 10 Reader (16-mm.). Details on this equipment are available from the Recordak Corporation, 350 Madison Avenue, New York 17, N. Y.

### **Camera Alignment**

Where any considerable amount of copying is done, it is desirable to have some kind of stand for holding the camera and the original so that the original is parallel to the film plane in the camera. Either a vertical or a horizontal camera stand can be used. If subjects of various sizes are to be copied, a horizontal stand with a sliding camera support may be desirable. A vertical stand is simple and preferable for subjects all of the same size. Whichever stand is used, the camera can be fastened to its support by a  $\frac{1}{4}$ -inch, 20-thread-per-inch bolt which engages with the tripod bushing. Permanently installed copying lights, preferably on swinging arms, can be added to either type of stand.

The Kodak Precision Enlarger Stand Assembly offers an excellent means of holding a small camera for copying. The enlarger head can be removed from the bracket and the camera attached to the bracket by means of the tripod socket screw.

In the case of vertical copying outfits, correct alignment can be obtained by making sure that both the camera back and the board for holding the original are perfectly horizontal; this can be checked with a spirit level. Another method, which can be used with horizontal as well as with vertical stands, is to place a mirror on the center of the easel. If the image of the lens, as reflected in the mirror, falls in the center of the camera ground glass, the mirror is at right angles to the camera axis.

**Bantam  $f/4.5$  mounted for copying on the stand for Kodak Portable Miniature Enlarger**



## Field Sizes of Copying Cameras

When the copying camera is equipped with a ground-glass focusing back, the field size or the area of the original which will be included on the negative can be determined easily by observation of the image on the ground glass. In some cases it is desirable to be able to see the limit of the field directly on the subject; this can be done by placing a light back of the ground glass, so that an image of the illuminated ground glass is projected through the camera lens onto the subject.

The approximate field size can be readily calculated from the formula,

$$\text{Field size} = \text{negative size} \times \frac{\text{lens-to-subject distance}}{\text{lens-to-film distance}}$$

## Adapting a Roll-Film Camera to Copying

An ordinary roll film camera is not so well suited to copying as a camera having a ground-glass screen, but it can be used with supplementary lenses for photographing originals larger than about 7 x 9 inches.

Focusing the camera for this work is done most readily with supplementary lenses. In the table on the next page, subject distances are given for the Kodak Portrait Attachment and for 1+, 2+, and 3+ Portra Lenses. These subject distances apply to all cameras and must be measured accurately between the subject and the supplementary lens. Exposures should always be made at a small aperture when a supplementary lens is used.

The camera can be mounted by a tripod screw for either a horizontal or vertical outfit. The camera-subject alignment for a horizontal stand must be secured by careful measurement and careful making of the parts involved. The vertical outfit can be aligned by careful construction and checked thus: The camera first should be adjusted so that the distance between the supplementary lens and the subject is that given in the table. The board which holds the subject should be made horizontal and checked with a spirit level, and the camera back should be leveled in a similar manner. A plumb bob, which should be suspended below the center of the supplementary lens, will indicate the approximate center of the subject. A line parallel to one edge of the included field can be established by sighting past one edge of the camera. If desired, the exact area of the subject included may be seen (if the camera construction permits) by opening the camera back and observing the image on a piece of ground glass or tissue paper stretched across the picture aperture, or by observing the subject through the



camera lens. The camera finder is not intended for close-up copying and should be disregarded.

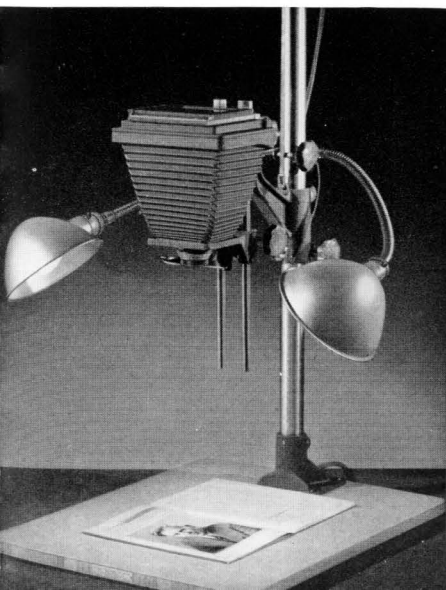
### Copying Arrangements—Kodak Precision Enlarger

The Kodak Precision Enlarger is intended primarily for enlarging, but it is so designed that, with a slight addition and rearrangement of parts, it can be converted for other work. With the addition of one of the Camera Back Adapters, the Bellows Assembly becomes a view-type camera with long extension bellows and interchangeable lenses. Since the enlarger stand forms a support for both the camera and the material to be copied, the material is aligned without difficulty.

**Negative Sizes:** There are two Camera Back Adapters for the Precision Enlarger A. One of these accepts  $2\frac{1}{4} \times 3\frac{1}{4}$ -inch Graflex Holders. The other takes the 6.5 x 9-cm. combination holders of the Recomar type, also the 35-mm. Kodachrome Adapter A and the Bantam Kodachrome Adapter A. A camera back adapter is supplied for the Precision Enlarger B which accepts  $3\frac{1}{4} \times 4\frac{1}{4}$ -inch (and 9 x 12 cm.) holders of the Recomar type, the 35-mm. Kodachrome Adapter B, and the Bantam Kodachrome Adapter B. These make possible a wide range of copying applications, as indicated in the table on the following page.

Lenses which are suitable for use with the Kodak Precision Enlarger embrace Kodak Projection Lenses from 2 inches to  $6\frac{3}{8}$  inches in focal length. The 4-inch lenses are of greatest utility for copying with the Stand

**Precision Enlarger B Assembly set up for copying.**



Assembly. Kodak Projection Ektar Lenses are especially recommended for color work and for all work demanding the most critical definition.

**Illumination:** The Copying Lights for the Kodak Precision Enlarger provide the lighting. The flexible arms facilitate adjustment of the lights for uniformity of illumination. When the originals are much larger than  $8\frac{1}{2} \times 11$  inches, lamps in reflectors on separate stands can be conveniently used.

**TABLE OF FIELD SIZES—KODAK PRECISION ENLARGER**  
(With Copy on Baseboard)

KODAK PRECISION ENLARGER A						
<i>Lens Used</i>	CAMERA BACK ADAPTER A (2¼ x 3¼ in.)		35MM KODACHROME ADAPTER A (24 x 36mm)		BANTAM KODACHROME ADAPTER A (28 x 40mm)	
	<i>Maximum</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Minimum</i>
2" f/4.5	2½ x 3½	1½ x 1½	1½ x 1½	¾ x ½	1½ x 2½	¾ x ¾
3" f/4.5	3½ x 5¼	1¾ x 1¾	3½ x 5¼	¾ x ¾	8½ x 12½	1½ x 1½
4" f/4.5	17 x 23¾	2½ x 3½	6½ x 9½	¾ x ¾	7¾ x 11¼	1½ x 1

KODAK PRECISION ENLARGER B						
<i>Lens Used</i>	CAMERA BACK ADAPTER B 9 x 12CM SHEET FILM		35MM KODACHROME ADAPTER B		BANTAM KODACHROME ADAPTER B	
	<i>Maximum</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Minimum</i>
4" f/4.5	5¼ x 7	1½ x 2	5 x 7	¾ x ¾	7½ x 11	¾ x ¾
5" f/6.3	15½ x 21½	1¾ x 2½	4½ x 6½	1½ x ¾	5½ x 7¾	1½ x ¾
5¾" f/4.5	15½ x 21¼	2 x 2½	4½ x 6½	1½ x ¾	5 x 7½	1½ x ¾
6¾" f/4.5	11¼ x 16¼	2½ x 3½	3¼ x 5	¾ x ¾	3¾ x 5¾	¾ x 1½

**LAMPS RECOMMENDED FOR COPYING (See next page)**

<i>Light Source</i>	BLACK-AND-WHITE COPYING		KODACHROME COPYING			
	<i>B-and-W Original</i>	<i>Colored Original</i>	Sheet Film		35mm and Bantam	
			<i>Daylight</i>	<i>Type B</i>	<i>Daylight</i>	<i>Type A</i>
Photoflood No. 1.....	×	×	—	—	×	×
Photoflood No. 2.....	×	×	—	×	×	×
3200°K, all sizes.....	×	×	—	×	—	×
250-watt lamps or smaller..	×	×	—	—	—	×
White Fluorescent.....	×	×	—	×	—	×
Daylight Fluorescent.....	×	×	×	—	×	—
White Flame Carbon Arcs..	×	×	×	—	×	—

\*With Kodachrome Filter for Photoflood. \*\*With Kodak CC4 Filter.  
 \*\*\*With Wratten Filter No. 78B (color rendering is not as good as with Photoflood Lamps).  
 †With Kodak Filters CC25 plus CC34.  
 ‡With Kodak CC34 Filter.  
 §With Kodak CC33 Filter.

§With Kodak CC23 Filter.

## ***Lighting the Original***

IN the lighting of flat work to be copied, the chief requisites are that the illumination over the subject be even (by having the lamps far enough from the original) and that none of the light be reflected into the camera lens from the surface of the original. It is recommended that two light sources be used, one on either side of the copy material, arranged so that the light strikes the material at about a  $45^{\circ}$  angle in order to prevent the specularly\* reflected beam from striking the lens. Reflections are also reduced by placing the original with its long dimension at right angles to the plane of the lights. Unevenness of illumination is most apparent when high-contrast negative materials are used.

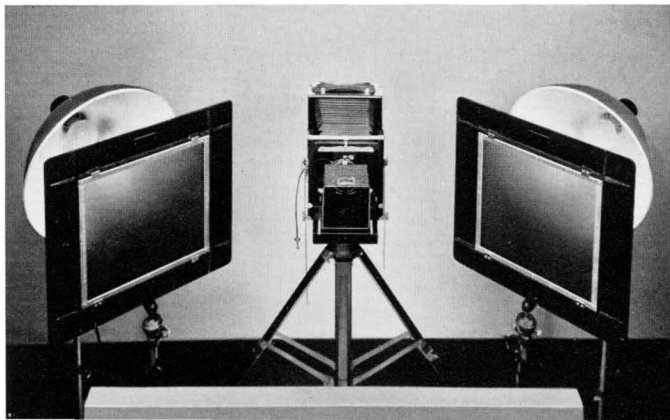
A photoelectric exposure meter is of value in checking the evenness of illumination. By placing a neutral card in front of the subject and scanning it with the meter, any unevenness in the illumination can be shown by variations in the needle deflection. Care should be taken that the shadow of the meter does not fall on the card and interfere with the proper reading of the light value, nor should the meter be held so that it picks up specular or bright reflections from the card. This is particularly important if the card is at all glossy.

### **Overcoming Reflection Troubles**

Trouble from reflections is frequently encountered in copying such originals as rough prints, matte prints, scratched, crumpled, or cracked prints, small rough-surfaced prints, daguerreotypes, tintypes, and glossy prints which show dents or ferrotype scratches. Each high spot in the surface of the print may cause specular reflections which give rise to an appearance of granularity in the copy print. Paintings which have strong reflections due to cracks, canvas texture, or brush marks, framed pictures, especially those under glass, and large originals, such as billboards

\*A specular reflection makes a surface appear glossy.

**Copying setup showing Pola-Screens at lens and lights.**





and murals, are frequently difficult to copy because of reflections.

Troublesome reflections arise from two sources: 1. Light from the camera front, operator's clothing, or a source behind the camera, reflected to the subject and back to the lens. 2. Light specularly reflected by the original directly from the copying lights.

The tendency toward the first type of reflection troubles may be reduced if the easel or holder for the original is painted black and its surroundings are kept as dark as possible. As a further precaution against these reflections, when a print of high gloss or a framed painting under glass is to be copied, it is advisable to take the picture through a hole in a large black card placed just in front of the lens.

Pola-Screens afford an effective means of overcoming reflection trouble of the second type. Two Kodak Lamp Pola-Screens (12 x 12-inch), one for each light, and one Kodak Pola-Screen for the lens are required. Detailed instructions for copying are included with Kodak Lamp Pola-Screens.

### **Obtaining Correct Exposure**

EXPOSURE is best determined by developing a trial film which has been given a series of exposures. Such a film shows the proper time and aperture for a given lighting setup, and as long as conditions and materials are unchanged no further trials are necessary. This applies to all line work—whether black on white or white on black—for while the total amount of light reflected is widely different, the tones to be recorded (namely white and black) are the same in both cases.

#### **Use of Photoelectric Exposure Meter**

In using photoelectric exposure meters, some consideration must be given to the type of subject being photographed. The meter reads the average brightness of the subject, but it may not always be this average brightness that determines the proper exposure. For instance, printed matter or a line drawing which is predominately white gives a high meter reading. On the other hand, white printing against black (a negative Photostat for example) gives a comparatively low meter reading, yet to be properly exposed these two originals should be given the same exposure. For such work, it is recommended that readings be taken on a *white* card placed over the material to be copied, and used with the white-card meter settings given in the Data Sheets and in the tables, pages 20 and 23.

As the exposure is rather critical for most copying work—especially line originals—it is advisable to make a series of test exposures based

on the recommended meter setting in order to determine from the developed negatives the best exposure meter setting for a particular copying setup and meter. Once the correct exposure is related to the meter response in this way, it should be possible to employ this calibration on any desired setup using the same equipment in the future.

### **Relative Aperture Change**

The distance from the lens to the image is increased for short subject distances so that the indicated relative aperture (that is, the  $f$ -number) is no longer effective. The exposure increase required can be determined conveniently without calculations by use of the Kodak Lens Guide, sold by Kodak dealers. However, the effective  $f$ -number can be obtained from the following formula:

$$\text{Effective } f\text{-value} = \frac{\text{Indicated } f\text{-value} \times \text{lens-to-film distance}}{\text{focal length}}$$

For example, a 10-inch lens racked out 5 inches from the infinity setting (to 15 inches from the film), and set at  $f/8$ , would have an effective  $f$ -value of  $f/12$ .

$$\frac{8 \times 15}{10} = f/12$$

A scale in inches on the lens track with a pointer on the camera front makes this method of computing effective  $f$ -values extremely easy.

## **Copying Copyrighted Material and Government Obligations**

### **Copyrighted Material**

It is unlawful to reproduce material bearing a notice of copyright without written permission of the copyright owner. Each reproduction of such material must carry a copyright notice.

### **Government Obligations**

*The law prohibits the copying of:* U. S. and foreign government obligations such as: currency, bonds, notes, or the like; canceled and uncanceled stamps; U. S. Government departmental identification cards, badges, or insignia; military or naval documents, etc., marked Secret, Confidential, or Restricted; certificates of citizenship, naturalization, or arrival, etc., or duplicates of same.

*The only exceptions to the above are the following:*

*U. S. and foreign stamps* can be copied for philatelic purposes, and in black-and-white only, providing that the reproductions are less than  $\frac{3}{4}$  or more than  $1\frac{1}{2}$  times the size of the original.

*Coins, U. S. and foreign*, can be photographed as desired for illustrating numismatic, historical, and educational publications.

This is only a brief summary of existing photographic restrictions, and the Eastman Kodak Company assumes no responsibility therefor. As the pertinent laws and regulations may change, legal advice should be obtained before reproducing the above or similar material.

## **Copying Requirements—Various Typical Originals**

### **CONTINUOUS-TONE ORIGINALS**

A good negative of a continuous-tone original, such as a painting or photograph, reproduces all the gradations of the original, contains no clear portions without detail and no dense, plugged-up areas. It resembles closely a negative of an average outdoor subject. To obtain such a negative, a film of moderate contrast is used, and more or less contrast is obtained, if required, by longer or shorter development. Kodak Commercial Films are especially recommended for copying continuous-tone originals; complete information is given in the Data Sheets. The table, *Continuous-Tone Copying Materials*, page 20, lists several materials which can be used and provides meter settings and development data.

### **Photographic Prints**

Black-and-white photographic prints, in good condition and on smooth matte or glossy paper, afford no special problems in copying. However, the reproduction will not be as good as that obtainable from a print made especially to be copied as explained below.

**Prints Made Especially for Copying** should be on glossy paper, should be somewhat lower in contrast than prints made for viewing, and should have full detail in both highlights and shadows. The lightest white should be slightly grayed over, while the darkest black should not be the deepest that can be recorded by the paper. Prints of this character can be copied with minimum loss of highlight and shadow detail. The negatives are developed to slightly higher than normal contrast to compensate for the lower contrast of the prints. Spotting or airbrushing should be done with neutral mediums such as Kodak Spotting Colors.

**Rough-Surfaced, Creased, or Wrinkled Prints** usually show troublesome reflections. Such reflections can be avoided by using Pola-Screens at the lights and at the camera lens. In some cases, reflections from scratches in the print surface or from slight wrinkles can be avoided if the print is flattened in a printing frame and copied through the glass.

**Small Prints**, if on other than glossy paper, give trouble because of sur-

face texture, which reproduces as a coarse graininess. Such trouble can be avoided by using Pola-Screens at lens and lights.

### **Old Photographs**

**Caution in Preparation of Old Photographs for Copying:** Since old photographs cannot be replaced, it is wise to make the best possible negative *before* attempting any cleaning or other preparation of the original. Then if the original should be damaged, it may be possible to prepare an acceptable print from this first copy negative.

Old photographs of all types sometimes are so badly damaged that the only procedure for obtaining a clean reproduction is first to make the best possible copy, then to build up the resulting print with spotting medium, or airbrush, and finally to recopy the retouched print.

**Soiled Prints** can often be cleaned by careful use of an artgum eraser, or by swabbing with cotton dampened with a mixture of half water and half denatured alcohol. Before being cleaned, the print should be examined carefully for any evidence of pencil work, spotting, or retouching which would be removed by cleaning. The cleaning treatment should first be tried on a small area at one corner of the print.

**Prints with Colored Stains or Spots,** having an image which is black and not faded, should be copied on a panchromatic film with a filter similar to but deeper in color than the stains.

**Faded Prints** usually have yellowed images of low contrast.

*Moderately faded prints* with fair detail in highlights and shadows should be copied on non-color-sensitive film such as Kodak Commercial Film or on Kodak Commercial Ortho Film through a blue filter.

*Prints badly faded* throughout shadows and highlights are best copied on Kodak Commercial Film, developed by inspection to the desired contrast in a high contrast developer. *In cases of extreme fading*, where these methods fail, the best possible copy negative should be made, and permission obtained from the owner to attempt restoration of the original with Kodak Stain Remover S-6. It can then be copied.

**Daguerreotypes** (mercury image on a silvered copper plate). The photographic image on a daguerreotype is extremely delicate and must be treated with great care. *If the surface is touched, a permanent mark will result.*

Daguerreotypes commonly show a great deal of dirt and stain. In many cases, most of the dirt is on the glass cover and the daguerreotype itself is in fairly good condition. If necessary, however, the daguerreotype can be cleaned by the treatment outlined in "Photographic Facts



**Copies of a badly faded photograph, low in contrast and yellowed by age;**  
**Left, made on a portrait film; right, made as recommended on page 17.**

and Formulas," Wall and Jordan, American Photographic Publishing Co., 1940. The operation is a delicate one and should not be attempted unless absolutely necessary.

The copy negative can usually be made on one of the films recommended for continuous-tone copying (table, page 20). If the contrast of the daguerreotype is very low, it may be necessary to use one of the materials recommended for copying line originals.

**Ambrotypes** (whitish silver image on a glass plate with a black backing) may be disfigured by cracking or flaking of the black backing on the glass. They can be restored by repainting the back with a jet black lacquer such as Kodak Brushing Lacquer No. 4—Dull Black. Films and development recommended for copying continuous-tone prints are also suitable for copying ambrotypes. When higher contrast is needed, it can be obtained by increasing the development time, or, in extreme cases, by using materials recommended for line copying (table, page 23).

**Tintypes** (whitish silver image on a black-lacquered metal plate) often show scratches, dents, and other blemishes. Fine scratches can usually be eliminated by rubbing the surface with a little Vaseline or mineral oil and wiping it off with a soft lintless cloth. Pola-Screens used over lens and lights will further reduce the effect of blemishes.

## **Photomechanical Reproductions and Works of Art**

**Photoengravings and Photolithographs.** If the pattern of the halftone screen is resolved in the copy negative, these originals should be treated as line copy. Overexposure of the negatives must be avoided.

If the halftone screen pattern is *not* resolved in the copy negative, originals of this type should be treated as continuous-tone copy.

**Photogravures** require the same technique as photographs.

**Posters and Lithographs** are usually continuous-tone in character, and can be copied in the same manner as paintings, discussed below.

**Paintings** and other colored continuous-tone originals can be copied in color with Kodachrome Film. High-key pastels may require  $\frac{1}{2}$  stop less exposure than average paintings; rich, low-key old masters may require  $\frac{1}{2}$  stop more. The best results in making black-and-white copies of paintings are obtained by using a suitable filter in combination with one of the panchromatic materials recommended for continuous-tone copying. The Wratten Filter Kodaguide is a valuable aid in selecting the proper filters for this purpose.

In the copying of oil paintings, the artist's brush marks often cause undesirable reflections. These may be reduced by changing the lighting angle. They can be most effectively controlled through the use of Pola-Screens at both lens and lights.

**Tapestry Figures and Textile Weaves** are copied much like paintings. The method of lighting depends on whether emphasis is to be placed on the colored figures or the weave and texture. A strong light from one side will accentuate surface texture. Standard copying illumination, that is, equal light from both sides of the camera, is best when figures are to be reproduced without showing the texture of the material.

**Pencil, Charcoal, and Crayon Sketches** require essentially the same technique as black-and-white photographic prints, but crayon sketches in color, like paintings, may require filters to secure maximum color differentiation.

**Etchings** and some pencil drawings, at first glance, appear to be line subjects. Actually, however, the lines differ in depth or tone as well as in width, and the different tones must be reproduced to obtain a satisfactory copy. Originals of this type should therefore be copied on continuous-tone copying materials; slightly longer than normal development may be desirable. If an etching shows a color wash, it may be possible to tone the copy print to reproduce this effect.

**TABLE: CONTINUOUS-TONE COPYING MATERIALS**

SENSITIZED MATERIAL	WHITE-CARD* EXPOSURE INDEX TUNGSTEN	KODAK DEVELOPER	RECOMMENDED DEVELOPMENT IN MINUTES AT 68° F (20° C)		WRATTEN SAFE-LIGHT SERIES
			Con- tinuous Agitation (Tray)	Intermit- tent Agitation (Tank)	
<b>Sheet Films</b>					
Commercial, Com- mercial Matte	1.5	DK-50	5	6	1
Commercial Ortho	2.5	DK-60a	4	5	
		DK-50	7	9	2
		DK-60a	5	6	
Super Ortho-Press	12	DK-50	5	6	2
		DK-60a	4	5	
		D-19	4	5	
Panatomic-X	5	D-76	13	16	Total Darkness
		DK-60a	4	5	
		DK-50	5	6	
		DK-20	14	18	
Portrait Pan	8	DK-50	5 ½	6 ½	Total Darkness
Super Panchro- Press, Type B	25	DK-50	5 ½	7	Total Darkness
		DK-60a	5	6	
		D-19	4	5	
Infrared†	2	D-76	6	7 ½	7
		DK-50	3	3 ½	
<b>Roll Films, Film Packs, Plus-X</b>	10	DK-60a	4	5	Total Darkness
		D-76	13	17	
		DK-20	13	17	
Infrared†	2	D-76	7	9	7
		DK-20	8	10	
<b>35mm Films</b>					
Positive Safety	0.25‡	D-76	4	5	OA
Panatomic-X	5	D-76	11	14	Total Darkness
		DK-20	11	14	
		DK-60a	3 ½	4 ½	
Direct Positive Pan	12	See instructions with film.			Total Darkness
Infrared†	2	D-76	7	9	7
		DK-20	8	10	
<b>Plates</b>					
Kodak 33	1.2	DK-50	4	5	1
		D-61a (1:3)	7	9	
Kodak Panchro- matic	2.5	D-76	7	9	3
		D-11 (1:1)	3	4	
Infrared-Sensitive†	0.1	D-11 (1:1)	2 ½	3	7
		D-19 (1:4)	3	4	
<b>Color Films</b>					
Kodachrome Prof. Type B	2§	Processed by Eastman Kodak Company			Total Darkness
Kodachrome Type A	4§				

\*Based on the normal position of the calculator being set at the reading obtained from a white surface in the copying position. These values are suitable for use with meters having ASA scales and with G. E., Weston, and similar meters.

†Infrared meter settings are based on exposure through Wratten A Filter.

‡To use, multiply by 10 and give 10 times indicated exposure.

§With Weston meters and with similar meters calibrated before 1946, use 1.5 for Type B film, 3 for Type A film. These settings also apply when line originals are copied on Kodachrome Film.

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## LINE ORIGINALS

A negative of a line original, such as a line drawing or typewritten page, must show high contrast between the two tones reproduced. For example, a copy negative of black lettering on a white background has high density in the background area and clear lettering. Good line negatives can be printed on any contrast grade of paper. The required contrast is obtained by using a material of extreme contrast and giving it high-contrast development. Materials for this purpose are listed in the table, *Line Copying Materials*, page 23. Such materials have limited exposure latitude and must therefore be exposed correctly. It is advisable to make exposure tests with each new copying setup.

Certain line originals, such as maps and some pencil drawings, show great variation in the width and weight of the lines. High-contrast line copying materials do not satisfactorily reproduce both fine, light lines and broad, dark lines at the same exposure level. Excellent copies of these originals can be made by the Kodak Fine Line Process, page 24. If legibility rather than high contrast is the primary consideration, these originals can be copied successfully on a continuous-tone copying material, and developed to somewhat higher than normal contrast. Use of a continuous tone material may also be advisable in copying line originals with varying background density.

### **Line Drawings and Tracings, Typed and Printed Matter, Handwriting, Sheet Music, Wood Cuts, and Linoleum Prints (in Black and White)**

These can be copied with any of the materials recommended for line copying. The focus must be critically sharp to avoid filling in of fine lines, and the negative should be fully exposed but not overexposed.

In making copies of drawings, letters, or other originals which are printed on one side only, it is desirable to back up the material with white cardboard or several thicknesses of white paper in order to increase the effective whiteness of the paper and give greater contrast. This is especially helpful with letters on thin paper.

If the sheet to be copied is printed on both sides, it should be backed up with black paper or a black card to keep the lines or lettering on the back from showing through.

Clearest typewritten originals are produced by typing through a carbon paper ribbon or unused carbon paper on white bond paper (the ordinary ribbon should not be used). The paper should be backed up with a second sheet of carbon paper, reversed to print on the rear surface. The contrast of these originals is further increased if they are backed up with a white card while being copied. Typewritten material



should not be crowded on a slide; the readable limit is about half of an 8½ x 11-inch page of double-spaced typing.

### Colored Line Originals

In copying colored line originals, the problem is to secure greatest contrast between the subject and the background. This is usually accomplished by means of high-contrast panchromatic film and a filter. If the subject is to be rendered *light* against a *dark* background, the filter should transmit the color of the subject and absorb the color of the background. However, if the subject is to be rendered *dark* against a *light* background, the filter should absorb the color of the subject and transmit the color of the background. (See table below.)

**Blueprints** are best copied on a panchromatic film through a red filter, Wratten A or F. The red filter absorbs blue light so that the blue background records as black, while the lines remain white.

**Printed or Written Matter in Colored Inks** usually requires a high-contrast panchromatic film and a contrast filter which *does not* transmit the color of the ink used, but which freely transmits the color of the paper stock. Filter recommendations are given in the table below.

FILTERS FOR COPYING COLORED LETTERING ON WHITE OR COLORED PAPER ON PANCHROMATIC FILM*		
<i>Paper Color</i>	<i>Ink Color</i>	<i>Wratten Filter</i>
White or Yellow	Blue	A
White	Red	C5
White or Yellow	Blue or Red	B
White or Yellow	Purple	B
Green	Black, Blue or Red	B
Blue	Black or Red	C5
Pink	Black or Blue	A

\*For filter factors, see *Data Sheets*.

**Checks** can be copied on Contrast Process Panchromatic Film. The ink is usually dark enough to record properly without the use of a filter.

**Documents on Yellowed Paper** with black or gray ink require a high-contrast panchromatic film and a deep yellow contrast filter such as the Wratten G. The G filter freely transmits the yellow light reflected from the yellowed paper so that the paper records as white, the ink as black.

**Manuscripts and Documents** on which the ink has faded to yellow or brown ordinarily yield best contrast on a non-color-sensitive film. With panchromatic film, a blue filter should be used.

**TABLE: LINE COPYING MATERIALS**

SENSITIZED MATERIAL	WHITE-CARD* EXPOSURE INDEX TUNGSTEN	KODAK DEVELOPER	RECOMMENDED DEVELOPMENT IN MINUTES AT 68° F (20° C)		WRITTEN SAFE-LIGHT SERIES
			Con- tinuous Agitation (Tray)	Intermit- tent Agitation (Tank)	
<b>Sheet Films</b>					
Contrast Process Ortho	12	D-8 (2:1) † D-11	2 4	— 5	1
Contrast Process Pan	16	D-8 (2:1) † D-11	2 4	— 5	Total Darkness
<b>Roll Film, Film Packs Plus-X ‡</b>	40	DK-60a	11	14	Total Darkness
<b>35mm Films</b>					
Micro-File	3.0	D-11	4	5	Total Darkness OA
High Contrast Positive Safety	2.0	D-11	4	5	
Positive Safety	3.0	D-11	7	9	OA
Panatomic-X ‡	25	DK-60a	11	14	Total Darkness
<b>Plates</b>					
Process	2.5	D-8 (2:1) † D-11	2 4	— 5	1
Process Pan	25	D-8 (2:1) † D-11	2 4	— 5	3
<b>Papers</b>					
Reflex Copy Paper A, XA		Versatol (1:3) ††Dektol (1:1) Dektol (1:2)	1 30 sec 45 sec	— — —	OA or OO
Reflex Tracing Cloth VA		Dektol (1:1)	45 sec	—	OA or OO
*These values are intended to serve as a guide in making trial exposures, and are suitable for use with meters having ASA scales, and with G. E., Weston, and similar meters. The values are based on normal position of calculator being set at the reading obtained from a white surface in the copying position. †2 Parts stock solution, 1 part water.    ‡Emergency use only.    †† Or Kodak D 72 11-46					

## COMBINED LINE AND CONTINUOUS-TONE ORIGINALS

When line and continuous-tone materials are combined, as in advertising layouts and photographic greeting cards, separate negatives of the two subjects should be made and combined in printing for best rendering of both subject types.

If both subjects must be copied on one film, some loss of quality is inevitable. Kodak Commercial Film should be exposed and developed for good reproduction in the continuous-tone material. This portion of the dry negative can be blocked out with Kodak Lantern Slide Varnish. When dry, the line part of the negative can be reduced slightly with Kodak Reducer R-4, then intensified.



Figure 1—Usual Effect of Printing for Fine Lines



Figure 2—Usual Effect of Printing for Heavy Lines



Figure 3—Result Obtained with Kodak Fine Line Process

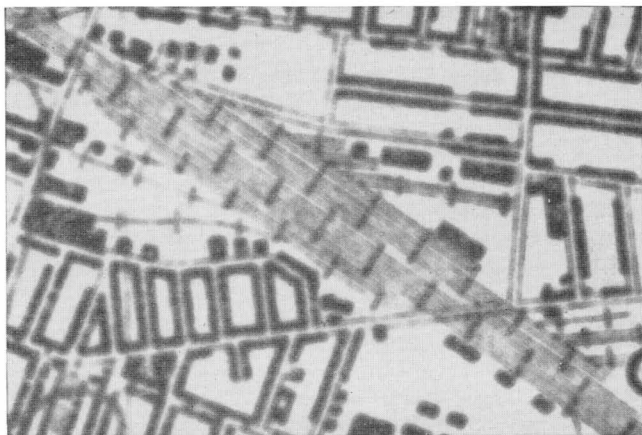
## ***Special Copying Techniques***

### **KODAK FINE LINE PROCESS**

THE Kodak Fine Line Process provides a means for making accurate reproductions of all types of line originals in which there is variation in the strength of the lines. Ordinarily, it is found that if a negative of such an original is printed long enough to bring out the fine lines of the original on the print, the heavier lines will tend to spread beyond their proper width. The result is a filling-in between lines and a serious loss of detail wherever the heavier lines are close together. This effect is shown in Figure 1.

A slightly shorter exposure improves the rendering of the heavy lines, but then the fine lines disappear as illustrated in Figure 2. Note the complete absence of the marsh symbols which appeared in the upper right-hand corner of Figure 1.

In the Kodak Fine Line Process, spreading of lines is eliminated by printing the negative in register with an unsharp positive transparency. The function of the unsharp positive is to provide automatic dodging so that each area of the print is given the most suitable exposure for accurate reproduction of the original. Figure 3, printed from the same negative used in Figures 1 and 2, shows the effect on the final print. The improvement is due solely to the action of the positive transparency in adjusting the printing exposure to the requirements



**Figure 4—Enlarged Section of Unsharp Positive Used in Printing Figure 3**

of the different areas. An enlarged section of the positive, corresponding to the railroad tracks in the upper left-hand corner of Figure 3, is illustrated in Figure 4.

### Making the Negative

Kodak Contrast Process Ortho Film is recommended. The exposure should be full, so that no detail is lost, even if the clear lines are veiled over to some extent. Exposure data and development recommendations appear in the Data Sheet for Contrast Process films.

### Making the Unsharp Positive

To make the positive, the Kodak Contrast Process Ortho negative is printed on Kodak Commercial Film in accordance with the special exposing procedure described in the following paragraphs.

**Position of Films:** The negative is placed in the printing frame face down so that the emulsion will be turned toward the light source during exposure. The base of the Contrast Process Ortho negative provides the correct amount of space between the negative image and the emulsion surface of the Commercial film. Figure 5 shows this arrangement.



Figure 5—Arrangement of Films for Making Unsharp Positive

**Angle of Illumination:** The printing light is placed obliquely as illustrated in Figure 6. This arrangement, in conjunction with the separation between the two emulsions, produces the proper degree of unsharpness in the positive. The light itself is an ordinary  $7\frac{1}{2}$ -watt frosted bulb used without any reflector or housing. *The bulb must be placed at the correct angle* with respect to the center of the printing frame; the proper ratio of the horizontal distance to the vertical distance is 1 to 2. The distances shown in the diagram can be increased or decreased to suit individual requirements, providing their ratio is maintained. However, the horizontal distance should in no case be less than the length of the diagonal of the negative. If the distances are too short, the image in the positive will be too large, and it will not be possible to register it properly with the negative.

**Rotation of the Printing Frame:** During the exposure of the positive, the printing frame must be rotated. Any convenient means can be used

to rotate the frame; the only requirement is that, for best results, it must make at least one revolution per second. The arrangement shown in Figure 6, consisting of a stationary wooden peg and a rotating wooden platform, is very simple to set up. If desired, it can be refined by the addition of a ball bearing between the peg and the platform. The turntable of a discarded phonograph is also a suitable support for the printing frame.

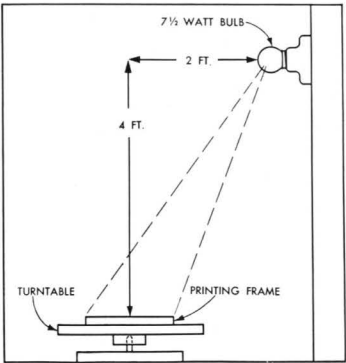


Figure 6—Arrangement of Exposing Light and Printing Frame for Exposure of Unsharp Positive

**Exposure Time:** The exposure time should be adjusted to give a low-density background, so that even the lightest details of the original are perceptible on the developed positive. The density range of the positive should be one-third to one-half that of the negative. Under these conditions, the appearance of the developed positive will be similar to that of Figure 4, and the exposure will be 5 to 20 seconds at the distances shown in Figure 6.

**Developing the Unsharp Positive**

Kodak Developer DK-60a (diluted 1:1) is recommended for the development of the unsharp positive. Recommended development is 4 minutes at 68° F. (20° C.), with usual rinsing and fixing.

**Printing the Combined Negative and Positive**

For printing, the negative and unsharp positive are combined in register, with their images separated by the thickness of the negative support. Prints can be made by contact printing on high-contrast paper such as Azo No. 5. The printer used must provide perfect contact between the negative, the positive, and the paper.

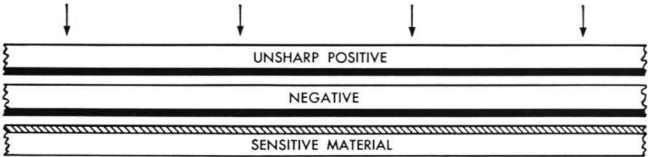


Figure 7—Arrangement of Combined Negative and Unsharp Positive for Printing

## FULL-COLOR COPIES WITH KODACHROME FILM

Copying with Kodachrome Film is done in the same manner as with black-and-white materials. For correct color rendering, however, Photoflood Lamps must be used with Kodachrome Film, Type A, or 3200° K. Lamps with Kodachrome Professional Film, Type B.

Correct exposure is essential. Exposure can be estimated by use of exposure meters, tables, or by making a range of test exposures varying by half a lens opening. With two Photoflood Lamps No. 1 in suitable reflectors at 40 inches, a typical exposure is 2 seconds at  $f/22$  for an  $8\frac{1}{2} \times 11$ -inch subject photographed on Kodachrome Film, Type A.

If a photoelectric exposure meter is used, it is well to take the reading of the illumination reflected from a surface of reasonably constant characteristics such as the back of a sheet of white Kodak Photographic Paper (e.g. Kodabromide N) or a white card. Care should be taken to hold the white surface in contact with the original and to keep shadows out of the area scanned by the meter. The exposure for average subjects then should be calculated from the continuous-tone, white-card meter settings given in the table, *Continuous-Tone Copying Materials*. Dark subjects usually require  $\frac{1}{2}$  stop more exposure; very light subjects,  $\frac{1}{2}$  stop less. In copying colored line originals with Kodachrome Film, the same method and the same white-card settings are required that are used for colored continuous-tone originals.

Certain white papers tend to appear bluish when copied on Kodachrome Film. This can often be remedied by making the exposure through one or two thicknesses of Wratten Filter No. 1.

Originals in printing inks of brilliant colors may yield Kodachrome copies having some loss in color saturation. It is also true that Kodachrome reproductions of some printing inks differ in hue from the original because of anomalous spectral characteristics of the inks.

## COPYING ILLEGIBLE DOCUMENTS AND QUESTIONED PAINTINGS

**Copying by Infrared Radiation:** Infrared photography may be useful in copying charred, deteriorated, altered, or overprinted documents, and in examining paintings.

*Filters and Lighting for Infrared Photography:* Infrared-sensitive films or plates, ordinary tungsten lamps or Photoflood Lamps, and a Wratten A Filter (red) are required for taking pictures by infrared light. The Wratten Filter No. 87 is desirable in some cases.

*Infrared Materials Available:* Kodak Infrared Films (miniature, roll and sheet) and Kodak Infrared-Sensitive Plates. For the high contrast required in documentary examination, these materials should be de-

veloped in Kodak D-19 for about 9 minutes at 68°F. Development recommendations for continuous-tone copying are given in the table, *Continuous-Tone Copying Materials*, page 20.

The technique is explained in detail in the book, "Photography by Infrared," by Dr. Walter Clark, published by Wiley & Sons, New York. General information on infrared photography is given in the Kodak Data Book, *Infrared and Ultraviolet Photography*, sold by Kodak dealers.

### **Copying by Ultraviolet Radiation**

Ultraviolet photography can often be used to detect faded or vanished writing, chemical erasures, and restoration in works of art.

When ultraviolet radiation strikes an object, some ultraviolet light is reflected; furthermore, many substances glow, or "fluoresce." Photographs can be taken in total darkness with an ordinary camera (no filter) by reflected ultraviolet radiation obtained by illumination with ultraviolet only. A G.E. Uviarc, or other ultraviolet source, in a light-tight box with a window of Corning Glass Filter No. 5860 (Violet Ultra), 10mm thick, is a suitable source. The fluorescence observed visually with this lighting can be photographed by adding a Wratten Filter No. 2A to the camera lens to absorb the reflected ultraviolet, which is much stronger photographically than the weak fluoresced light. The exposures required in photographing reflected ultraviolet are usually less than a minute at  $f/16$  on Contrast Ortho Film. Photographs of fluorescence made on Portrait Panchromatic Film through the Wratten Filter No. 2A may require exposures as long as one hour at  $f/4.5$ .

Certain commercial ultraviolet lamps, in which the glass itself is an ultraviolet-transmitting filter, transmit too much visible light to permit the faint fluorescence of documentary subjects to be photographed. Additional information about ultraviolet photography appears in the Data Book, *Infrared and Ultraviolet Photography*.

### **COPYING NEGATIVES AND TRANSPARENCIES**

Negatives (and other transparencies) can be copied by (a) contact printing, (b) enlarging on film or plates, or (c) transilluminating the negative in front of a copying camera. In the case of (c) care must be exercised to be certain that no light is reflected from the front surface of the illuminated negative. If any light is reflected from the front of the negative, it will interfere with the rendering of highlight details. A lighttight tunnel from the negative being copied to the lens can be used to avoid any possibility of troublesome reflections.

The Kodak Data Book, *Slides*, provides more detailed information about copying negatives and transparencies.



## **Duplicate Negatives from Intermediate Positives**

Duplicate negatives can be made by means of an intermediate positive. A film positive is made from the original negative, and is then printed on another piece of film to produce the duplicate. Kodak Commercial or Commercial Matte Film is recommended for both steps. The matte surfaces of the latter film are advantageous for doing retouching between original and duplicate.

The intermediate positive and the copy negative can be printed by contact, or one or both can be printed by projection, to produce a copy which is larger or smaller than the original. However, for some subjects it is not advisable to enlarge Commercial Matte Film more than 4 diameters. Greater enlargement may show up the grain in the matte, especially in small prints.

The exposure for the intermediate positive should be sufficient to give a slight density in even the brightest highlights, and development should be adjusted to give a soft positive which is somewhat flatter than would be desirable for a transparency intended for viewing. Any necessary dodging can be done during the printing of the positive. A mask should be used to block stray light coming around the sides of negatives. Films with antihalation backing should be used in both cases.

## **REFLEX COPYING—Kodak Reflex Copy Paper**

Kodak Reflex Copy Paper A and XA are thin-base, high-contrast, orthochromatic materials intended for making same-size copies of printed pages, documents, drawings, and other line originals without the use of a camera. (See Data Sheet.)

If the original has printing on both sides, the Reflex Copy Paper is placed in contact with the surface to be copied, and the exposure made by directing light through the back of the sensitive paper. With correct exposure, the light passing through the sensitive paper barely affects it, but the light reflected back by the white areas of the subject gives sufficient additional exposure to result in a satisfactory negative. The negative image is reversed left-to-right; it can be read by transmitted light, or printed by contact on Reflex Copy Paper to obtain a positive print.

For copying originals which have printing, typewriting, or drawing on one side only, Reflex Copy Paper can simply be exposed by contact. True images can be obtained, if desired, by placing the back of the original in contact with the emulsion.

Data—KODAK MICRO-FILE FILM (35MM)

**General Properties:** An extremely fine-grained, slow, panchromatic emulsion on safety base, especially designed for making greatly reduced copies of newspapers, manuscripts, line drawings, letters, etc. It should be used in all cases where the copy negatives represent more than a tenfold reduction in size.

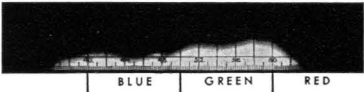
**White-Card Exposure Index for Copying Line Originals: Tungsten 3**

This exposure index is intended to serve as a guide in making trial exposures, and is suitable for use with meters having ASA scales, and with G. E., Weston, and similar meters. The value is based on normal position of calculator being set at the reading obtained from a white surface in the copying position.

**Exposure:** With two No. 1 Photoflood Lamps (new lamps, rated voltage; slight increase needed after about 1 hour in use) in Copying Lights for Kodak Precision Enlarger or in Kodak Handy Reflectors at 40 in.: 1/5 sec. at f/6.3 (effective aperture); as the contrast is high, the exposure will be critical. Trial exposures are consequently advisable.

**Color Sensitivity:** Panchromatic.

Spectrogram to Tungsten Light



**Filter Factors:**

	K2	G	A
TUNGSTEN	1.5	2	6

For copying aged manuscripts or books with yellowed paper, the Wratten K2 or G Filter may be of aid in securing adequate contrast. For copying blue-prints, the Wratten A Filter is recommended.

**Contrast:** Recommended development in Kodak D-11 gives a gamma of approximately 4.0.

**Recommended Development:**

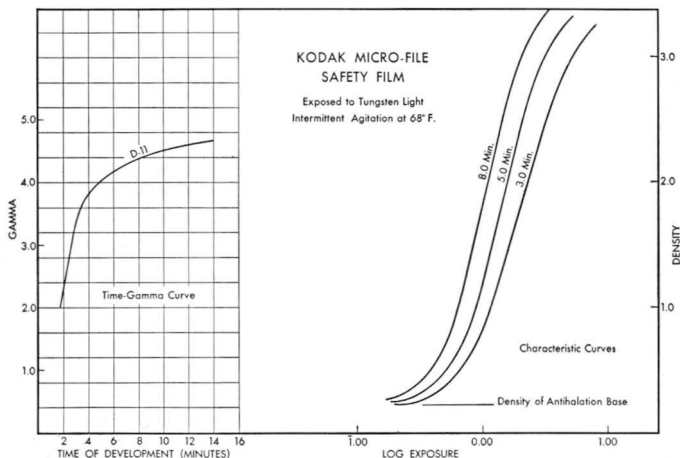
DEVELOPER	USE	CONTINUOUS AGITATION 68° F (20°C)	INTERMITTENT AGITATION* 68° F (20°C)
Kodak D-11	High contrast; line copying	4 minutes	5 minutes
*Agitation at one-minute intervals during development.			

Kodak Developer D-19 also gives good results.

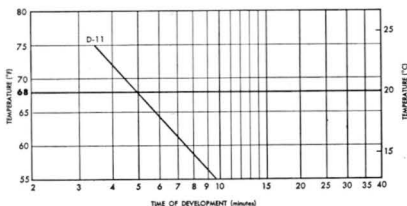
**Graininess:** Extremely low. Permits very great enlargement without visible grain.

**Resolving Power:** 160 lines per mm. This figure for resolving power is based on optimum exposure, subject contrast of 30 to 1, and recommended development.

**Sensitometric Curves:** These data are for average product and processing and are sufficiently accurate for all ordinary photographic work. For special problems, the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curve** showing the developing times at various temperatures corresponding to the times at 68° F as given in the table of Recommended Development. Lines for other contrasts can be drawn parallel to the present line and through the respective points for the times at 68° F as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Fixing:** Rinse in water, fix 10 to 20 minutes at 68°F (20°C) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder with Hardener.

**Washing and Drying:** Wash 30 minutes in running water, remove to another wash tray or tank and swab with cotton while submerged in the water, then rinse under a faucet. Wipe carefully with a soft sponge or chamois to remove water drops from surface and dry without the use of a fan and in a location as dust free as possible.

**Safelight:** Total darkness, or Wratten Series 3.

**Rolls Available:** 35-mm — M135 magazine (36 exposures), and bulk 35mm rolls as follows: No. 401 (50 ft.), No. 402 (100 ft.), and No. 403 (200 ft.).

Data—KODAK CONTRAST PROCESS ORTHO and  
CONTRAST PROCESS PANCHROMATIC FILMS (*Antihalation*)

**General Properties:** These films have extremely high contrast and fine grain, and are intended for making line copies. The short toe region (see sensitometric curves) allows particularly sharp separation of the light and dark tones and thus produces extremely clear lines.

**Contrast Process Ortho** is useful for copying both black-and-white originals and certain types of colored copy, such as telegrams, maps, drawings, where yellow-green or blue-green hues predominate. It can be used with the filters listed below and can be developed by inspection under a suitable safelight.

**Contrast Process Panchromatic** is sensitive to all colors and is recommended especially for copying colored originals, such as maps, drawings, or documents which have been drawn or printed with colored inks, and for photographing faded originals of low contrast. All filters can be used with this film.

**White-Card Exposure Index for Copying Line Originals:** These values are intended to serve as a guide in making trial exposures, and are suitable for use with meters having ASA scales, and with G. E., Weston, and similar meters. The values are based on normal position of calculator being set at the reading obtained from a white surface in the copying position.

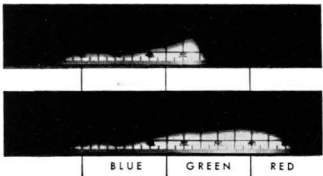
Contrast Process Ortho	Daylight 20	Tungsten 10
Contrast Process Panchromatic	Daylight 20	Tungsten 12

**Color Sensitivity:**

*Spectrograms to Tungsten Light*

Contrast Process Ortho  
Orthochromatic

Contrast Process Panchromatic  
Panchromatic, Type B



Filter Factors:		K1	K2	K3	G	F	A	B	C5	POLA-SCREEN	
											E. TYPE 1 KODAK
Contrast Process Ortho	*White Flame Arc	2	3	4	6	—	—	—	—	6	2.5
	Photoflood	1.5	2	2.5	4	—	—	—	—	4	2.5
Contrast Process Panchromatic	*White Flame Arc	—	2	3	5	32	16	12	6	4	2
	Photoflood	—	1.5	2	2.5	10	5	6	16	3	2

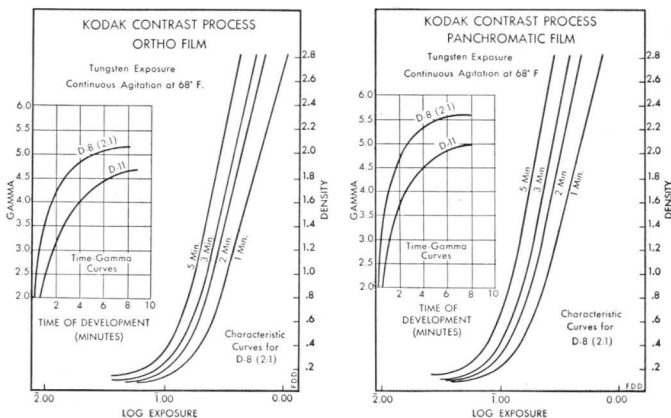
\*With the anode in the lower position.

**Contrast:** Extremely high. Recommended development in Kodak D-11 gives a gamma of about 4.0, Kodak D-8 yields slightly higher contrast. The short toe of the curve helps to increase the effective contrast.

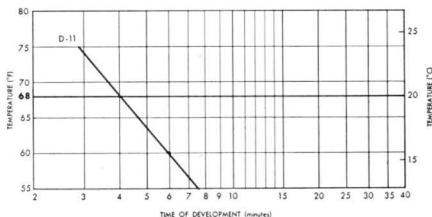
Recommended Development:		CONTINUOUS AGITATION (TRAY) 68° F (20° C)	INTERMITTENT AGITATION* (TANK) 68° F (20° C)
DEVELOPER	USE		
Kodak D-8 (2:1)†	Maximum Contrast and Density	2 min.	—
Kodak D-11	High Contrast	4 min.	5 minutes

\*Agitation at one-minute intervals during development.  
†2 parts stock solution, 1 part water.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F as given in the table of Recommended Development. Lines for other contrasts can be drawn parallel to the present line and through the respective points for the times at 68° F as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*

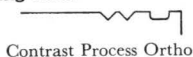


**Resolving Power:** Contrast Process Ortho—125 lines per mm; Contrast Process Pan—80 lines per mm. These figures for resolving power are based on optimum exposure, subject contrast of 30:1, and recommended development.

**Fixing:** Rinse for about 20 seconds in Kodak Stop Bath SB-1a; fix 10 to 20 minutes at 68°F (20°C) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5, or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash for 30 minutes in running water.

**Safelights:** Contrast Process Ortho, Wratten Series 1 (red); Contrast Process Panchromatic, total darkness preferred, but Wratten Series 3 (dark green) may be used.

**Notching Code:**



Contrast Process Ortho



Contrast Process Panchromatic

**Sizes Available:** All regularly listed sheet-film sizes.

## Data—KODAK COMMERCIAL, COMMERCIAL MATTE, AND COMMERCIAL ORTHO FILMS (*Antihalation*)

**General Properties:** Emulsions of medium speed and fine grain capable of giving a fairly high degree of contrast, especially suitable for copying continuous-tone subjects and for general commercial work.

**Commercial** is useful for copying black-and-white continuous-tone originals, such as photographs. It is blue sensitive only.

**Commercial Matte** is similar to Commercial but has a matte emulsion and a matte back to permit pencil retouching on either or both sides without retouching varnish.

**Commercial Ortho** is recommended for copying many types of colored, continuous-tone originals, for photographing light-colored furniture, and for other commercial work which does not require a red-sensitive film.

**Film Exposure Index:**

Commercial	Daylight	<b>25</b>	Tungsten	<b>6</b>
Commercial Ortho	Daylight	<b>32</b>	Tungsten	<b>10</b>

These values are suitable for use with meters having ASA scales, and with G. E., Weston, and similar meters.

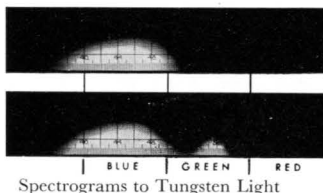
**White-Card Exposure Index**, based on normal position of calculator being set at the reading from a white surface in the copying position:

Commercial	Daylight	<b>6</b>	Tungsten	<b>1.5</b>
Commercial Ortho	Daylight	<b>8</b>	Tungsten	<b>2.5</b>

### Color Sensitivity:

Commercial  
Blue sensitive only

Commercial Ortho  
Orthochromatic



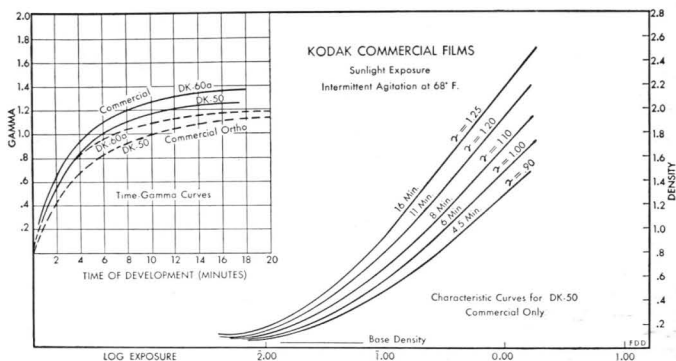
**Contrast:** A range of contrasts is available by proper choice of developer and development time. Maximum practical gamma with Kodak DK-50, about 1.2.

### Recommended Development:

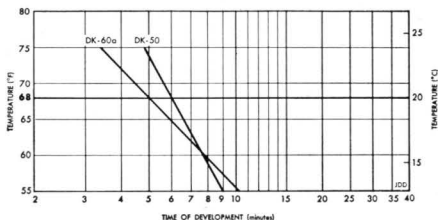
DEVELOPER	FILM	CONTINUOUS AGITATION (TRAY) 68° F (20° C)	INTERMITTENT AGITATION* (TANK) 68° F (20° C)
Kodak DK-50	Commercial	5 minutes	6 minutes
Kodak DK-50	Commercial Ortho	7 minutes	9 minutes
Kodak DK-60a	Commercial	4 minutes	5 minutes
Kodak DK-60a	Commercial Ortho	5 minutes	6 minutes

\*Agitation at one-minute intervals during development.  
Kodak D-61a also gives good results.

**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F as given in the table of Recommended Development. Lines for other contrasts can be drawn parallel to the present line and through the respective points for the times at 68° F as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Moderate.

**Resolving Power:** 50 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development in Kodak DK-50.

**Fixing:** Rinse thoroughly in water or Kodak Stop Bath SB-3 (during hot weather); fix 10 to 20 minutes at 68° F (20° C) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5; wash 20 to 30 minutes in running water.

**Safelight:** Wratten Series 1 (red).

**Notching Code:**



Commercial



Commercial Matte



Commercial Ortho

**Sizes Available:** All regularly listed sheet-film sizes.

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## Data—KODAK PANATOMIC-X SHEET FILM (Antihalation)

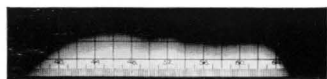
**General Properties:** A very fine grain, high quality panchromatic film of moderate speed and contrast. The fineness of grain makes it particularly suited for photomural work and any other applications where a considerable degree of enlargement is required. It is suitable for outdoor or indoor photography when the highest speed is not needed, and excellent for copying continuous-tone originals. The best balance between fine grain and speed is secured from development in Kodak Developer D-76.

**Film Exposure Index:** Daylight **32** Tungsten **20**

These values are suitable for use with meters having ASA scales, and with G. E., Weston, and similar meters.

**White-Card Exposure Index**, based on normal position of calculator being set at the reading from a white surface in the copying position: Tungsten **5**

**Color Sensitivity:** Panchromatic Type B.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

**Filter Factors:** (Correction Filters: Daylight, K2; Tungsten, X1.)

	K1	K2	K3	G	A	B	C5	F	N	C4	X1	POLA-SCREEN	
												TYPE 1	KODAK
Sunlight	1.5	2	2	3	8	6	5	16	8	12	4	4	2
Tungsten	1.5	1.5	1.5	2	4	6	10	8	8	25	3	3	2

**Photoflash Exposures:** These data are for average subjects in average rooms with light-colored walls and ceilings. For dark subjects in dark-colored surroundings or outdoors at night, give four times the indicated exposure.

GUIDE EXPOSURE NUMBERS*	SM	No. 5	No. 11	No. 22	No. 31
Kodak Senior and similar synchronizers—1/100 sec.	—	115	125	190	—
Kodak Junior Synchronizer—1/50 sec.	70	135	—	—	—
Focal-plane shutter synchronizers—1/100 sec.	—	—	—	—	75

\*Divide by distance in feet from lamp to subject to find *f*-number.

**Contrast:** Moderate. Wide range possible by varying development times in recommended developers. Recommended times give gammas about 0.9. Maximum practical gamma with DK-60a about 1.6.

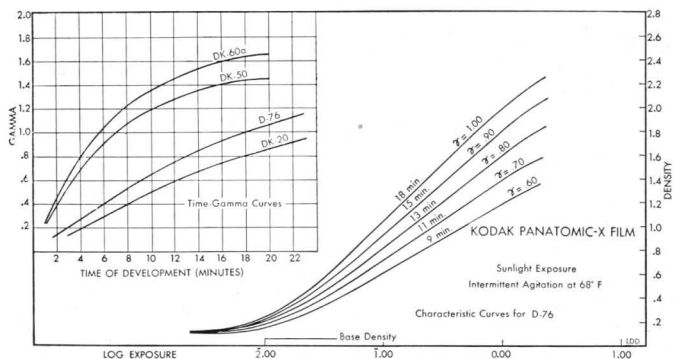
### Recommended Development:

DEVELOPER	USE	CONTINUOUS AGITATION 68° F (20° C)	INTERMITTENT AGITATION* 68° F (20° C)
D-76	General	13 minutes	16 minutes
DK-60a	General	4 minutes	5 minutes
DK-50	General	5 minutes	6 minutes
Microdol	Extremely fine grain	13 minutes	16 minutes
DK-20	Extremely fine grain	14 minutes	18 minutes

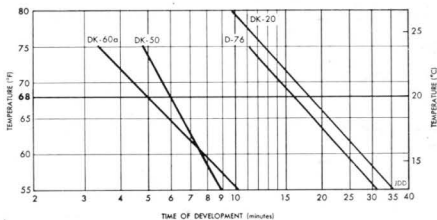
\*Agitation at one-minute intervals during development.



**Sensitometric Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under the actual working conditions.



**Time-Temperature Development Curves** showing the developing times at various temperatures corresponding to the times at 68° F as given in the table of Recommended Development. Lines for other contrasts can be drawn parallel to the present line and through the respective points for the times at 68° F as determined from the time-gamma curves above. *Best results are obtained at 65° to 70° F.*



**Graininess:** Very low. Permits great enlargement without noticeable grain even without special fine-grain processing.

**Resolving Power:** 55 lines per mm. This figure is based on optimum exposure, subject contrast of 30:1, and recommended development in Kodak D-76.

**Fixing:** Rinse in water or Kodak Stop Bath SB-3 (during hot weather), fix 10 to 20 minutes at 68° F (20° C) in a fresh acid hardening fixing bath such as Kodak Fixing Bath F-5 or the solution prepared from Kodak Acid Fixing Powder, with Hardener; wash 20 to 30 minutes in running water.

**Safelight:** Total darkness preferred. Wratten Series 3, dark green, at 3 feet with 10-watt bulb, for only a few seconds after development is one-half complete.

**Notching Code:**



**Sizes:** All regularly listed sheet film sizes.

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## Data: KODAK REFLEX COPY PAPER A, XA, AND TRACING CLOTH VA

**General Properties:** Kodak Reflex Copy Papers carry a high-contrast, orthochromatic emulsion designed for making same-size copy negatives and positives from line originals by the reflex copy method. No camera is required, the exposure being made through the back of the sensitive paper while the emulsion side is held in close contact with the copy. Typical line originals copied by this method are printed pages, documents, charts, line drawings, and coarse-screen halftones.

Reflex Copy A can be laminated *base down* to glass in order to make large reflex copy negatives which will hold exact size. The extra light weight stock of Reflex Copy XA conserves filing space. Tracing Cloth VA is used in making photo-tracings from drawings by regular contact printing methods.

PRODUCT TYPES	SURFACE	STOCK	AVERAGE THICKNESS
A	Smooth, Lustre	Light Weight	.0054
XA	Smooth, Lustre	Extra Light Weight	.0044
VA	Smooth, Matte	Tracing Cloth	.0045

**Color Sensitivity:** Orthochromatic.

**Relative Speed:** Suitable for contact printing.

**Contrast:** High—one contrast for all types of line work.

**Filter Recommendation:** For blueprints, yellowed copy, or blue ink, Wratten K2. Filter factor for tungsten light—2.5.

**Safelight:** Kodak Reflex Copy Paper should be handled and developed by the light of a Wratten Safelight, Series 0A (greenish-yellow) or Series 00 (yellow), used in a suitable safelight lamp.

Recommended Development—68° F (20° C)			
MATERIAL	DEVELOPER	DEVELOPMENT TIME	Agitate material thoroughly during development, keeping it under the solution as much as possible.
Reflex Copy Paper	Versatol (1:3)	60 sec.	
	*Dektol (1:1)	30 sec.	
	Dektol (1:2)	45 sec.	
Reflex Copy Tracing Cloth	Dektol (1:1)	45 sec.	
*Or Kodak D-72.			

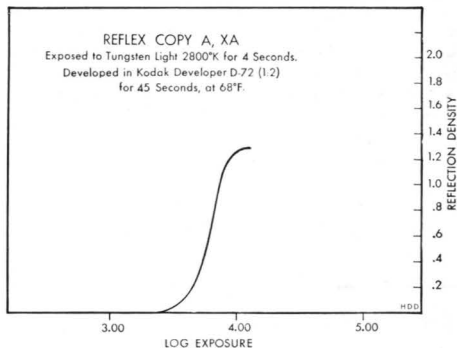
**Acid Stop Bath:** Rinse prints about 30 seconds in fresh Kodak SB-1 with agitation.

**Fixing:** Fix 5 to 10 minutes at 68° F (20° C) in a fresh acid fixing bath such as Kodak F-1 or the solution prepared from Kodak Fixing Bath for Industrial and Recording Papers. Agitate frequently.

**Washing:** Reflex Copy A and XA, one hour in running water with agitation, or five minutes in each of 12 changes of water. Rate of flow should change water completely every five minutes. Tracing Cloth VA should be washed for 15 to 20 minutes in running water; prolonged washing is not recommended. For best results, temperature of wash water should be 65° to 70° F (18° to 21° C).

**Drying:** Remove as much excess water as possible by squeegeeing or draining. Dry paper prints face down on clean cheesecloth stretchers, between clean photo blotters, or on a belt dryer. Dry glass-mounted negatives in racks, using a fan or drying cabinet if available.

**Characteristic Curves:** These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems the material should be calibrated under actual working conditions.



**Sizes Available:** All standard engineering, architectural, and legal sizes in sheets from 8 x 10 to 36 x 42 inches and in rolls 20, 30, 36, and 40 inches wide. Reflex Copy A and XA are also available in rolls 42 inches wide.